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Communication and Resilience in Collaboration, Social-Ecological Systems, and Discourse

Bridie McGreavy

COMMUNICATION AND RESILIENCE IN COLLABORATION, SOCIAL-ECOLOGICAL SYSTEMS, AND DISCOURSE

By

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COMMUNICATION AND RESILIENCE IN COLLABORATION, SOCIAL-ECOLOGICAL SYSTEMS, AND DISCOURSE

By Bridie McGreavy

Dissertation Co-Advisors: Dr. Laura Lindenfeld and Dr. Linda Silka

An Abstract of the Dissertation Presented
in Partial Fulfillment of the Requirements for the
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How does communication connect with and shape resilience and sustainability? I understand communication as a dynamic and context dependent concept. I draw my understanding of communication from systems, materiality, and discourse theories. I employ a mix of quantitative, qualitative, and critical approaches in three discrete projects focused on collaboration, social-ecological systems, and discourse.

In the first project, my collaborators and I ask: how does an understanding of complex communication dynamics help identify ways to improve participation for intended collaboration outcomes across scales? We explore this question through a two-year mixed methods study of interdisciplinary collaboration and stakeholder engagement in Maine's Sustainability Solutions Initiative. Our results demonstrate that decision making, collective communication competencies, participant identities and motivations, and social learning influence mutual understanding, inclusion of diverse ideas, and progress towards sustainability-related goals. Attending to how interactions recursively structure individuals, teams, and organizations may foster intentional transformation across scales.

In the second project, we ask: how does communication influence conservation planning and the realization of resilience as organizational mission? We address this question through an ethnography using participant observations, focus groups, and interviews to study and inform Frenchman Bay Partners' collaboration. In this project, we identify core process characteristics that help us collectively *work the tides*. In our efforts to promote resilience and sustainability we recognize that difference is necessary and productive. By maintaining process commitments such as checking the tide charts, creating intentional interventions, and by continually coming back to find ways to work together we promote sustainability.

The third project is a discourse analysis of resilience using Foucauldian archaeology in which I ask: how does resilience become a thing to be known? I identify two primary problems with resilience discourse, namely the lack of attention to how language creates the conditions what becomes possible and how this limits creative and transformative insights for working with the world. The artifacts I investigate include resilience's origins in ecology, systems ontologies and attractor models, and dialectics as ordering strategies. I seek transformation of the discourse and conclude by proposing a shift to materialist, vibrant assemblages for enhanced resilience and sustainability.

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CHAPTER 1

INTRODUCTION

1.1. Introduction

Complex problems are the starting point for sustainability science (Kates et al., 2001). Deeply entangled social, ecological, and economic problems have been described as "wicked" due to their cross-scale interactions, indefinite thresholds, and apparent intractability (Kreuter, Rosa, Howze, & Baldwin, 2004). Maine's Sustainability Solutions Initiative (SSI) recognizes the need to develop innovative solutions to myriad problems in Maine, including issues related to water quality, urbanization, climate and energy, forest landscape change, invasive species, and more. Following SSI's mission, my dissertation intends, through the study of communication, to find better ways to live with complex problems for sustainability.

I explore communication and resilience in three distinct projects. While the questions, theories, and methods across my chapters are diverse, there are common threads that link them together. Overall, I adopt a transdisciplinary orientation within sustainability science, a commitment which intends to produce knowledge that matters for diverse individuals and communities. Transdisciplinarity focuses on creating stronger relationships between science and societies for enhanced decision making (Jahn, Bergmann, & Keil, 2012; Klein, 2004). The results I share in the first two chapters inform how people working collaboratively can improve their processes for enhanced sustainability outcomes. My critical analysis in the third chapter reveals some of the limits for how we think about and act within our collective efforts for sustainability. From this work, I propose new modes of responsiveness and creativity in the face of dynamic change. This is a dissertation with a purpose: to bring communication to

sustainability science so our collective efforts to work across disciplines, with stakeholders, and within discourse may be improved through interaction design, process commitments, and critical attention.

In this introduction, I describe the context for my research by introducing SSI. I then summarize my understanding of sustainability, resilience, and communication and how these perspectives inform my research across the chapters. I use distinct methods in three separate projects, each of which constitute a chapter. These methods include a combination of quantitative, qualitative, and critical approaches. The methods are mixed, however the methodology is situated within a transdisciplinary design characterized by engaged and emergent research phases. I conclude with a summary of the questions, methods, results, and key insights from each project.

1.2. The Sustainability Solutions Initiative

Maine's SSI represents one of the largest, most extensive interdisciplinary efforts to adopt a solutions-oriented approach to sustainability science (Kates et al., 2001). SSI research occurs in diverse settings, with diverse partners, focused on diverse problems, all of which address sustainability issues. Three specific examples of team projects illustrate some of the rich experiences occurring within this collaboration network and the commitment within sustainability science to work across disciplines and with stakeholders to produce science that matters for society. A documentary featuring these projects can be viewed in the Emmy-award winning films in the series *Sustainable Maine* by the Maine Public Broadcasting Network (MPBN), available online (Ferrel, 2012).

In the vernal pool project, researchers are working with municipal planners across the Maine to develop landscape scale strategies to conserve important wetland habitats

while minimizing impacts on private property and residential development (Calhoun & DeMaynadier, 2008). As part of this collaboration, interdisciplinary team members devised innovative ways to track amphibians to learn more about their movements across different landcover types, which will inform town and state regulations to more effectively balance conservation and economic development. In the emerald ash borer project, collaborators recognized the imminent threat that an invasive insect, the emerald ash borer, poses to Wabanaki communities (Voggesser, Lynn, Daigle, Lake, & Ranco, 2013). The basket-making culture, origin stories, and resultant livelihoods within these communities depend on the brown ash tree, a species that may disappear if the emerald ash borer reaches Maine forests. Members of this team, including basket-makers and faculty from diverse disciplines, worked together to create an emergency response plan and adaptive strategies to mitigate this threat. In a third and final example, the Belgrade Lakes Region is home to waterways that are vital to the ecology of the region which also supports a tourist-based rural economy and community members' sense of place and history. On this team, natural and social science researchers and historians collaborated with community members to understand the multiple values associated with lakes in the region and make informed decision in the face of changes in landscape development, water quality, and climate.

As these projects demonstrate, SSI is about aligning research with the needs of communities to ensure that science can inform decision making and lead to more sustainable practices across a range of issues related to landscape change. Bringing together more than 15 disciplines in over 12 higher education institutions, SSI illustrates the challenges of aligning research across disciplines and with community partners.

Through our work on the Knowledge↔Action team, we have identified ways to address those challenges and to create a place for diverse forms of communication research within sustainability science (Lindenfeld, Hall, McGreavy, Silka, & Hart, 2012; McGreavy, Hutchins, Smith, Lindenfeld, & Silka, 2013).

1.3. Sustainability, Resilience, and Communication

Through research within SSI, I have come to understand sustainability in two ways. First, sustainability is a continual process, a striving together that is made possible through myriad interactions among humans and the world (Whitehead, 1978). Sustainability is also the values that emerge from process that continually condition what this process becomes. Unlike some who have advocated resilience as a replacement concept for sustainability (Zolli & Healy, 2012), I argue that resilience and sustainability are fundamentally complementary. Resilience is the dynamic responsiveness that makes sustainability go. Resilience is an open space of affectability that creates the conditions so that in our mutual striving towards sustainability, we can influence each other and work gets done.

Because these are my underlying assumptions about resilience and sustainability and I intend to study communication within efforts to promote both, I similarly need an understanding of communication that is dynamic and flexible. I see communication as a context-dependent concept that refers broadly to what emerges from interactions among human and material ecologies (Scott, 1973; Stormer & McGreavy, Under review). Importantly, I do not define communication as one thing or another but as a dynamic way to understand multiple levels of experience.

1.3.1 Context for Communication Research

As described above, I understand communication as dynamic and context-dependent phenomena. How I study communication across this dissertation comes from at least three overlapping contexts which produce tensions in this attempt to create a cohesive research project and achieve multiple goals: produce use-inspired knowledge; grow collaborative capacity in diverse settings; complete a dissertation and start an academic career; and more. In this research, I intend to produce scholarship that will be useful in multiple forms of collaboration and in academic publications. These goals can be but are not necessarily compatible given the different needs and standards among collaborator and academic knowledge communities.

This tension reflects the kinds of paradoxes that emerge in engaged research where the "most immediate reaction has been to try to resolve the contradictions, to fix the problems reflected in the paradoxes, to somehow simplify and rationalize the partnership [and research] process" (Silka, 1999, p. 344). Silka (1999) advises that instead of rushing to resolve the paradoxes, we acknowledge them and find creative ways of working through for new insights. Taking up this paradox, this was a research project that responded to a request for communication study that would inform partnership development and stakeholder engagement. Second, this was also a dissertation project in which I needed to produce scholarship that would contribute new insights to a field of inquiry that would serve as foundation for an academic career.

What came of these needs are studies of communication that draw from theories that connect with the kinds of questions collaborators in SSI and the Frenchman Bay Partners asked about group communication and stakeholder engagement (Daniels &

Walker, 2001; Giddens, 1984; Senecah, 2004; Thompson, 2009). The study then follows additional questions that emerged in the process of *doing* research, which included embodied practices of fieldwork, coursework, and related writing projects (Barad, 2007; Foucault, 1972; Whatmore, 2006). This is an effort to produce use-inspired sustainability science and communication research that is meaningful to collaborators, rigorous in its design, and academically innovative as well.

This research occurred with diverse collaborators. Due to this production context, from this point forward I alternate between "I" voice and "we" voice depending on who was involved at each particular stage of the project and how the insight emerged. Because the research I describe in Chapters 2 and 3 was collaborative from start to finish and I intend to co-publish with research team members and community collaborators, I use "we" in these chapters. My ability to conduct research is supported by an academic community of mentors and colleagues, all of whom have influenced the development of the discourse analysis in Chapter 4. Yet I follow standard writing convention for single-authored publications in this chapter and adopt the "I" voice. Although I alternate voices based on who was involved in the research and who will be involved in developing these manuscripts for publication, I led all of the writing for this dissertation.

1.4. Transdisciplinary Research Design

The standpoints from which I approach sustainability, resilience, and communication, all of which emphasize process, change, emergence, mutual vulnerabilities, and multiple realities require a research design that can accommodate these assumptions. I do this by taking up a transdisciplinary engaged research design. There are two distinct orientations that differentiate engaged research as a form of

knowledge production. First, engaged research assumes a commitment to egalitarianism, inclusion of diverse perspectives, and an orientation towards mutual empowerment and access. Second, engaged research aspires towards problem solving within complex systems (Trickett & Espino, 2004; Van De Ven, 2007). With these points of focus, engaged research is a complementary design within the field of sustainability science to promote a transdisciplinary connection between science and society (Jahn et al., 2012; Kates et al., 2001).

Given these underlying assumptions, it becomes necessary to consider the philosophies of knowledge that accommodate an orientation towards egalitarianism, diversity, and complexity. The recurrent terms "ecology" and "complex" reveal the implicit systems paradigm associated with this research approach. Engaged research occurs within a complex adaptive system where the world is composed "of many interconnected parts that are constantly self-organizing and adapting in response to their environment" (Ramage & Shipp, 2009, p. 241). This view has implications for how we design research which "*cannot* be given in advance; it must emerge, develop, unfold" (Lincoln & Guba, 1985, p. 225). Thus, engaged research within a complex adaptive system embraces emergence.

If the design cannot be laid out in advance because the inherent complexity requires room for emergence, how do researchers structure methodology? In this case, method is also structured emergently which means a methodological arrangement of theory and technique that "can comprise qualitative methods or quantitative methods or a combination of these two types of methods" (Hesse-Biber & Leavy, 2008, p. 2). The focus on egalitarianism also encourages the researcher to go beyond quantitative and

qualitative methods to take up critical methods that allow an analysis of power and production (Mumby, 1997). An emergent research design is characterized by thorough and continual considerations of the needs for information based on literature review, dialogue with research partners, and observations within the research. Emergent research follows a rigorous methodology depending on the type of method it employs and yet it remains open to change based on new insights and needs (Hesse-Biber & Leavy, 2008).

1.5. Chapter Summaries

I briefly describe each chapter, highlighting the questions, design, results, and primary conclusions to provide a map through the remainder of this dissertation. In the second chapter, entitled *Resilience and Collaboration: Communication in Teams as Complex Systems*, we describe research on interdisciplinary collaboration and stakeholder engagement in SSI. Interdisciplinary collaboration and stakeholder engagement within sustainability science research teams intends to improve the application of science and democratic engagement with science in society. Communication dynamics among individuals on these teams influence how outcomes, such as use of science in decision making, mutual understanding across disciplines, and the development of democratic engagement within science, emerge across scales. This chapter offers a systems-based approach to describe and improve communication on sustainability science teams characterized by interdisciplinary collaboration and public participation. Our communication systems framework draws from Giddens' (1984) structuration theory and systems theories of collaboration and public participation. We focus on how rules and resources in social interactions influence the degree, quality, and outcomes of collaboration. Our results, which draw from a two-year study of SSI, demonstrate that

decision making, collective communication competencies, participant identities and motivations, and social learning influence mutual understanding, inclusion of diverse ideas, and progress towards sustainability-related goals. Recursivity paired with resilience shows how interactions create the seeds for social structure within individuals, teams, society and social-ecological systems. Attending to how rules and resources influence human interactions creates the conditions for intentional transformation across scales.

In the third chapter, entitled *Working the Tides: Building Collaborative Capacity in Frenchman Bay*, we describe a study of collaboration among the Frenchman Bay Partners. In our effort to build collaborative capacity among diverse partners, such as clam diggers, mussel harvesters, eelgrass ecologists, state agency representatives, and others we identify process characteristics that help us collectively *work the tides*. In our efforts to promote resilience and sustainability we recognize that rough seas are inevitable and necessary. Checking the tide charts in our process allows us to understand the dimensions of difference in the Bay and create opportunities for diverse perspectives to inform collaborative planning. We intentionally create opportunities for dialogue among groups through boundary work strategies. We keep coming back in our ongoing commitment as Partners to grow capacity in the Bay. In doing so, we promote sustainability by becoming tidal in our interactions.

In the fourth chapter, entitled *Resilience as Discourse: Breaking Down the Box*, I describe how resilience is a concept that is gaining increasing attention in diverse public arenas, including news stories, grant funding initiatives, and conservation organization missions. In this critical analysis, I focus on resilience as

a discourse within academic knowledge production about Social Ecological Systems. I ask: What is the history of ideas about resilience? How might we compose the discourse differently such that a more dynamic, inclusive, and sustainable sense of resilience becomes possible? Through an archeological method, I identify two primary problems with how resilience operates, namely the lack of attention to how language creates the conditions what comes to be seen as possible as resilience and how this limits creative and transformative insights for working with the world. The artifacts I investigate include resilience's origins in ecological sciences, systems ontologies and attractor models of change, and dialectics as ordering strategies. I seek transformation of the discourse and conclude by proposing a shift to a materialist, vibrant assemblage for enhanced resilience and sustainability.

In the fifth and final chapter, I pose and work through three questions that ran throughout these studies, including what of communication, resilience and sustainability; what do we do with difference; and how do we work with the world? I summarize some of the constraints, focusing on power and proxemics, and then discuss further research I intend to advance from these projects. I conclude with a reflection on dissertation as becoming.

CHAPTER 2

RESILIENCE AND COLLABORATION: COMMUNICATION IN TEAMS AS COMPLEX SYSTEMS

2.1. Introduction

Interdisciplinary teams that involve citizens in research on complex social-ecological problems aim to develop use-inspired science to improve adaptive capacities and democratic engagement with science in society (Palmer, 2012). However, as Miller et al. (2008) note in their discussion of cross-disciplinary collaboration, those seeking to work together across disciplinary and institutional boundaries must attend to "the relevance of accommodating and integrating disparate values, epistemologies, and knowledges toward a more robust understanding of complex issues—issues of sustainability that bear considerable import in our rapidly changing world" (p. 13). If we collectively intend to promote democratic practices of science in society and resilience in social-ecological systems, we must sow the seeds for those outcomes within scientific research teams.

The intention to improve the use of science in decision making and to promote broader changes in the publics' engagement with science causes us to ask: what are the communication dynamics that influence the degree, quality, and outcomes of collaboration on sustainability science teams? How does an understanding of complex communication dynamics help identify ways to improve participation for intended outcomes across scales? Our study of communication on interdisciplinary, stakeholder-driven scientific research teams demonstrates how socially-defined outcomes, like sustainability and democracy in science, begin within teams and must be conceptualized as part and parcel of a broader system of collaboration.

Public participation in scientific research (PPSR) and sustainability science offer related ways of working across disciplines and with citizens on complex social-ecological research problems. Both promote resilience and sustainability (Cash et al., 2003; Dickinson, Louv, & Bonney, 2012; Kates et al., 2001; Shirk et al., 2012) and assume that strengthening collaboration among diverse participants builds adaptive capacities like social learning at individual, team, organizational, and social-ecological systems scales (Ballard & Belsky, 2010; Chapin, Folke, & Kofinas, 2009; Folke et al., 2010). Multiple efforts in PPSR analyze the components and outcomes of different forms of participatory research (Bonney, Ballard, et al., 2009; Bonney, Cooper, et al., 2009; Brossard, Lewenstein, & Bonney, 2005; Dickinson et al., 2012; Miller-Rushing, Primack, & Bonney, 2012). Shirk et al.'s (2012) framework for deliberate design represents an important synthesis that calls "explicit attention to the social and interactional dimensions that affect the quality of participation" (Shirk et al., 2012, p. 4). Focusing on team social interactions is a particularly important aspect of PPSR and sustainability science. This is an area that needs further attention to improve partners' and project leaders' abilities to integrate multiple perspectives into collaborative processes and promote desired project outcomes (Jordan, Ballard, & Phillips, 2012; Zoellick, Nelson, & Schauffler, 2012).

We use a systems approach to study communication in complex organizations (Giddens, 1984; Norton, 2007; Poole & McPhee, 2005; Thompson, 2009) and integrate core ideas from communication theory with the framework for deliberate design in PPSR (Shirk et al., 2012) and resilience thinking (Folke et al., 2010; Goldstein, 2012; Walker, Gunderson, et al., 2006). We draw on a two-year study of communication within a statewide sustainability science network, Maine's Sustainability Solutions Initiative

(SSI), to empirically develop the concepts we propose in the framework. Our work contributes an understanding of the communication dynamics of social interaction on teams to help foster sustainability-related outcomes across individual, team, organizational, and social-ecological systems scales.

2.2. Application of Structuration Theory

The study of human communication as a system focuses on how social interactions and environmental contexts influence each other to produce emergent wholes, like teams, institutions, and social-ecological systems (Giddens, 1984; Monge, 1977). Until recently, empirical work informed by communication theory and methodology has largely been absent from sustainability science and public participation literatures (Lindenfeld et al., 2012). However, communication as a field of study has much to offer an understanding of human interactions in social-ecological systems.

Much like Stokols et al.'s (2013) discussion of the value of a social ecology perspective within resilience and related areas, studying communication as a system helps explain social interactions and identify ways to grapple with complexity in collaborations (Giddens, 1984; Norton, 2007). In a systems approach, communication occurs in interactions, and meaning emerges from interactions at multiple scales (Miller & Miller, 1992; Monge, 1977). Attending to communication within teams enables us to study how components converge to produce meaning and emergent wholes (Giddens, 1984). Our research draws from multiple systems perspectives, but we use Giddens' (1984) structuration theory to organization our framework for four reasons on which we expand below. First, structuration is described as a mid-level theory that can be used as a sensitizing device to understand and organize study of complex interactions (Giddens,

1984; Norton, 2007; Stones, 2005). When paired with more empirically refined systems theories, structuration can be usefully grounded within a methodological approach. Second, and related to its use as a sensitizing device, structuration theory offers a process orientation that helps trace the part-to-whole relationship. Third, structuration provides a way to study human agency as a pattern of actions. Fourth and finally, this theory uses the concept of recursivity, or the cyclical, embedded, and mutually influencing relationship between structure and social interactions. We argue that recursivity meaningfully contributes to resilience theory's discussion of dynamic change by emphasizing responsiveness and mutual influence at all levels of interaction (Folke et al., 2010; Goldstein, 2012).

2.2.1. Process Orientation

Structuration offers a process orientation with an emphasis on the part-to-whole relationship in which social structure forms through social interactions. In structuration, interactions are guided by *rules* and *resources* (Giddens, 1984). A rule is synonymous with a routine or set of established practices. Resources are anything material or immaterial that people can use in action (Poole & McPhee, 2005). Resources may consist of tangible materials like grant funding and reward structures and less tangible but still influential resources like knowledge, motivations, decision making spaces, and personal relationships (Giddens, 1984). *Structure* is the relationship between rules and resources as people participate in and create the system of which they are a part.

While we distinguish between rules and resources, Giddens' concept of duality of structure requires that we also see these as integrated and mutually influencing. Recursivity "assumes that structure and process interact, and furthermore, that they both

change through mutual interaction" (Hernes & Bakken, 2003, p. 1512). Stones (2005) proposes that the dichotomy "internal" and "external" is a better way study the duality of structure than focusing on rules and resources because it provides a better foundation for empiricism. We maintain the focus on rules and resources, recognizing that there are other ways to understand these sets of practices and sources and constraints on capacity (Stones, 2005). Dialectics such as rules-resources and internal-external offer opportunities to organize the study of complex interactions; as frameworks they also always exclude other ways of characterizing complexity.

2.2.2. Human Agency

In structuration, human agency refers to the flow or pattern of actions (Pozzebon & Pinsonneault, 2005). When understood as a pattern of actions, agency can be studied through empirical observation. The empirical ability to link micro-practices of actors exhibiting agency to produce larger patterns of organization is a unique feature of structuration, with demonstrated application in diverse research contexts, such as in the Maine game warden service (Sherblom, Keränen, & Withers, 2002), public participation in environmental policy settings (Norton, 2007), and school districts as complex organizations (Canary, 2010). In structuration, decision making constitutes a space of interaction and an important resource that influences human agency. Decision space may help create the conditions in which participants develop trust and competence in their ability to participate effectively, which promotes agency (Daniels & Walker, 2001; Norton, 2007; Senecah, 2004). Collective communication competence (CCC) is also a systems concept and a resource that influences interactions and agency. CCC highlights how interactions that promote laughter, respect, reflexivity, and demonstrated presence

enhance a teams' communication while those that undermine it include sarcasm, jockeying for power, demonstrated boredom, among others (Thompson, 2007, 2009). These communication constructs are not fixed entities but socially-defined norms that emerge through and continually structure interaction (Giddens, 1984). Teams that develop an inclusive decision making process in which members can, in a respectful and sometimes humorous way, interact by posing questions, making suggestions, and sharing insights, also create a space in which collaborators demonstrate agency to collectively determine the degree and influence the quality of participation (Norton, 2007; Thompson, 2009).

2.2.3. Recursivity and Resilience

Structuration draws on *recursivity*, or the mutual influence of structure and social interactions in which systems themselves contain the seeds for their own maintenance and transformation (Hernes & Bakken, 2003). Recursivity describes self-referential, mutually responsive patterns of interaction that influence emergent order. Etymologically, recursivity refers to "running throughout" (Stormer, 2013) and is a process concept that brings another layer of dynamism to resilience, with roots in the idea that things "bounce back" (Goldstein, 2012). Recursivity assumes that if we want to encourage specific outcomes in society, like democratic engagement with science, we must also have inclusive, democratic approaches within teams.

We understand resilience as a way to think about responsiveness through a bundle of ideas that includes adaptive capacities, transformation, and sustainability (Folke et al., 2010; Goldstein, 2012; Walker, Holling, Carpenter, & Kinzig, 2004). Resilience provides a lens through which we can understand patterns of responsiveness in social

interactions and how these patterns influence collective abilities to maintain a system or transform it. The integration of recursivity and resilience promotes a fluid sense of emergence, one more aligned with dynamic social interactions (Goldstein, 2012; Stokols et al., 2013) than the attractor model with its roots in physics and ecology (Holling, 1973; Walker et al., 2004). Together, recursivity and resilience show how patterns of responsiveness move across temporal and spatial scales because interactions are always set within self-similar, cyclical, and mutually influencing modes of production.

2.3. Communication Systems Framework

This brief review of structuration sets up a pathway into our communication systems framework (Figure 2.1), in which we demonstrate how this theory can be used to understand features of social interaction on sustainability science teams. Responding to the need to contribute to the emerging field of public participation in scientific research, we use Shirk et al.'s (2012) framework as a foundation. Starting at the bottom of the framework, we provide a box showing the specific rules and resources we identified in our study of communication in SSI. The rules are the routine set of practices, such as the habitual ways in which collaborators describe each other (i.e. typologies); communication technologies and meeting strategies; how frequently collaborators communicated with one another; and defined levels of involvement. Resources are those material and immaterial features drawn on interaction, such as decision making approaches, CCC, identities and motivations, and dynamics of social learning.

Moving upward through the framework, the arrows indicate how rules and resources influence micro-practices. These are the observable patterns of agency on teams as different types of stakeholders, like scientists and citizens, convene to develop

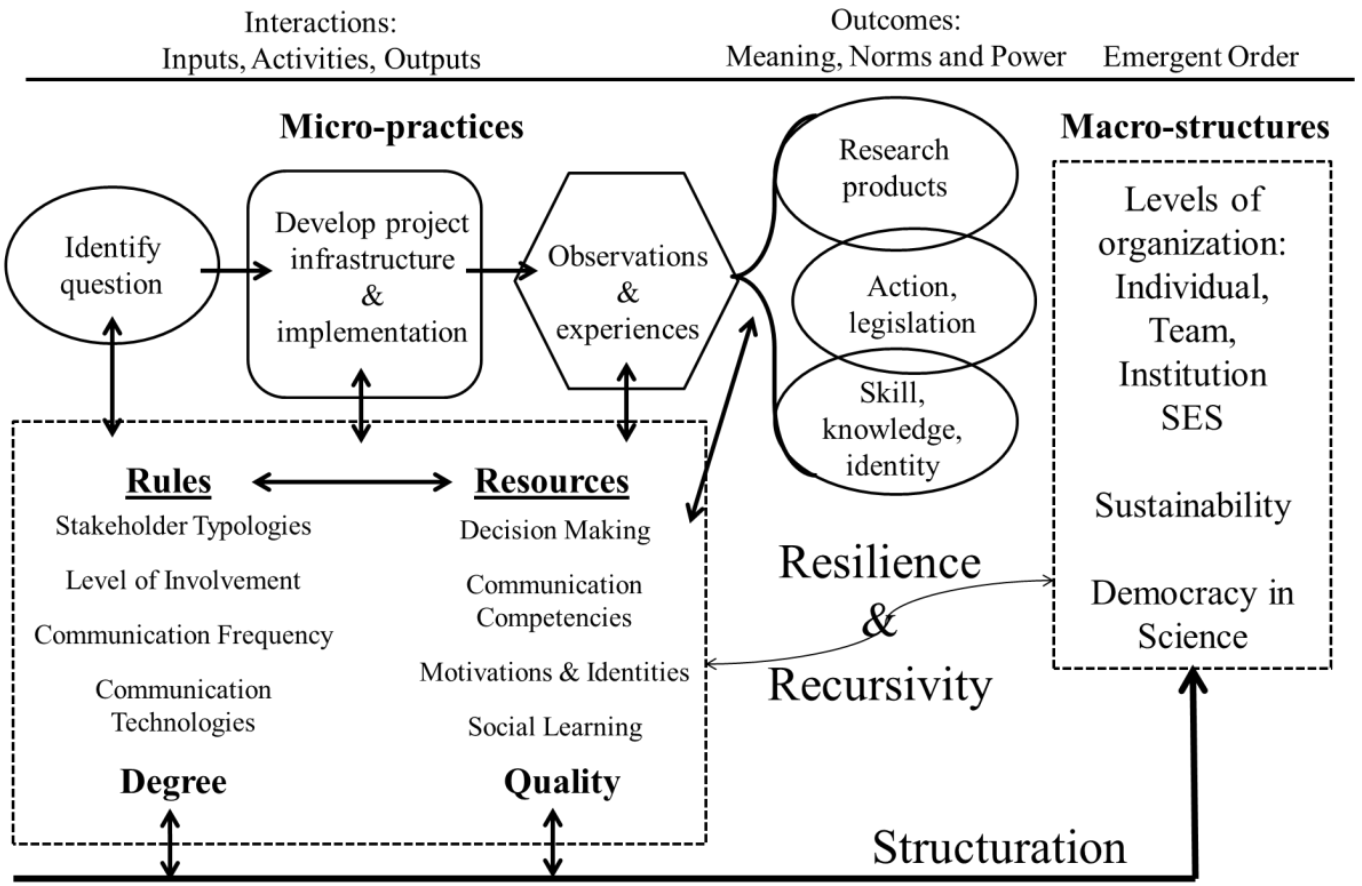

Figure 2.1. Our communication systems framework builds from Shirk et al.'s (2012) deliberate design in PPSR to identify systems-based communication interactions at individual, team, organizational, and social-ecological scales. This model identifies key process variables, including specific rules and resources, which influence social interactions and outcomes in emergent systems of order

research questions, define project infrastructure, and conduct investigations. For example, if a team uses a consensus-based decision making approach (resource) and meet face-to-face (rule), the micro-practices through which they identify questions and conduct research on their team are quite different than if they use a single-person decision making model and communicate exclusively through e-mail. These different micro-practices guided by rules and resources result in specific outcomes, or the production of meaning, norms, and power. Research products, policy development, and individual attributes like skills, knowledge, identities, and positions within the social structure of the system are measurable types of outcomes from collaboration. Set up in this way, we can create an observable link between process variables, including decision making, and outcome variables, such as mutual understanding.

Following the arrows in the other direction through the framework, structuration demonstrates how rules and resources simultaneously influence the degree and quality of participation. The pairing of resilience and recursivity in the framework intends to show how persistent patterns of responsiveness and the cyclical relationship between macro-structures and micro-practices create mutually influencing and dynamic tensions. These tensions create patterns of order at individual, team, institutional, and social-ecological levels of organization; in sustainability as a socially defined value; and in realization of the goal of democracy in science (Giddens, 1984). In sum, understanding how people on teams communicate, how they make decisions, develop identities, learn from each other, and define sustainability within teams provides a window into how these interactions and outcomes begin to run throughout the entire system.

2.4. Methods

2.4.1. Scope and Questions

Our study focused on interdisciplinary collaboration and stakeholder engagement in SSI. This five-year $20 million National Science Foundation (NSF)-funded project involved more than 150 faculty members and graduate students representing over 15 disciplines across the natural and social sciences from 12 institutions of higher education in Maine. Research teams also included stakeholders, with participants from a wide range of contexts including municipalities, state and federal agencies, non-profit organizations, individual citizens, tribal groups, and more. These teams focused on diverse issues related to landscape change, such as climate and energy, water and urbanization, and forest management to address complex problems in these areas and develop applied solutions, such as installing technological innovations in appropriate ways, creating new legislation, and promoting a science-literate citizenry. Our overarching research objective was to understand and describe communication practices to help improve interdisciplinary collaboration and stakeholder engagement on these teams using structuration theory paired with empirically grounded systems theories (Daniels & Walker, 2001; Morgan, 1997; Thompson, 2009). As stated above, our research questions asked: what are the communication dynamics and how do these influence the degree, quality, and outcomes of collaboration on sustainability science teams? How does an understanding of complex communication dynamics help identify ways to improve participation for intended outcomes across scales?

2.4.2. Research Design and Analysis

We employed a mixed-methods research design in four primary phases that included: 1) participant observations throughout the project; 2) qualitative interviews (n=41); 3) an online survey; and 4) member-checking interviews with key informants (n=5) to ground-truth observations (Corbin & Strauss, 2008; Creswell, 2003; Dillman, 2007; Patton, 2002; Vaske, 2008). In the first research phase, we initiated participant observations at all organizational events including regular all-team meetings, conferences, informal learning events, and annual retreats in which the first author took detailed field notes starting in October, 2010 through May, 2013. We interviewed 41 faculty members and graduate students using a purposive sampling strategy that invited participation from University of Maine and University of Southern Maine researchers who serve as the hub for the grant (Appendix B). Interviews lasted approximately one hour, and audio recordings were fully transcribed, resulting in more than 600 pages of single-spaced transcripts. We used modified grounded theory with stages of inductive content analysis to develop an initial code book for the interviews (Corbin & Strauss, 2008; Creswell, 2003). A core team of researchers independently coded interviews and collaboratively developed a codebook in multiple rounds of coding and triangulation. The first author then coded all of the interviews to sentence level using NVivo 9 software.

We conducted an online survey using Qualtrics software of a comprehensive sample of participants in the network (n=156) (Appendix C). The survey consisted of 26 primary questions that used 5- point Likert scale, preference ratings, and text boxes and took approximately 20 minutes to complete. Prior to the implementation of all survey

instruments, we solicited expert review to assess question clarity and response patterns (Dillman, 2007; Vaske, 2008). Survey questions asked participants to rate the extent to which they agreed or disagreed with statements like "My team rarely shows respect for diverse opinions" and "My ideas are frequently incorporated into the project and team decisions." We also asked participants to rate stakeholders' involvement in their research and complete the statement "I was motivated to engage stakeholders in my research because…," which offered options identified through the SSI interviews and literature on different types of motivations (Deci & Ryan, 2008; Gagne et al., 2010). The online survey was active July 10th through August 30th, 2012 and data were imported into to the Statistical Package for Social Sciences (SPSS) Version 19. In addition to descriptive analyses, we created a summative scale of CCC variables and tested the internal reliability using Cronbach's alpha (Vaske, 2008). Negative responses were recoded to match response patterns for calculating means and sums. We conducted chi-square analyses to test differences among groups of participants in their assessment of decision making, communication, and outcomes. We used Pearson correlation analyses to describe associations among these variables. We also conducted an exploratory Principal Components Analysis (PCA) with a varimax orthogonal rotation on a set of questions that explored researcher motivations to engage stakeholders (Hair, Black, Babin, Anderson, & Tatham, 2010). We used the Kaiser criterion to select components with eigenvalues ≥ 1.0, and we used a multi-step process of interpretation to identify and retain components (Hair, et al., 2006). We used a listwise deletion approach for dealing with all missing data (Vaske, 2008).

Finally, we used participant observations and interviews with key informants (n=5) to member check our interpretations (Appendix D) (Patton, 2002). We selected key informants based on their role and position within SSI an organization. We invited participation from select administrators, faculty, and a student who were involved in multiple teams and cross-project collaborations; represented biophysical and social science perspectives; and participated in SSI events and learning activities (Patton, 2002).

2.5. Results

2.5.1. Summary

Inductive content analysis of interview transcripts revealed five major themes and 36 sub-themes related to interdisciplinary collaboration and stakeholder engagement (Table 2.1). We received a 56% (n=88) response rate for the online survey with at least one respondent from every team in the organization (22 total teams), 45% of respondents from social sciences, 36% from biophysical sciences, and the remaining 19% comprised of interdisciplinary fields such as environmental and marine sciences, engineering, humanities, and other.

Table 2.1. Interview coding structure and frequency showing major themes, sub-themes, and the total number of interviews coded for that sub-theme. Example quotes are provided for each theme and representative sub-theme from interviews and/or survey text data.

Theme	Sub-theme	# interviews coded
1) Decision making **Single-person strategy, student role:** "[For this team], I'm the primary decision maker. I try and protect the Co-PI's. Grad students carry out the work."	**Models:** Single person	14
	Consensus based	26
	Core group	17
	Project & Problem Specific	20
	Lack of decision making	1
	Roles and Issues Student roles	15
	Stakeholder roles	12
2) Interdisciplinary Partnerships **Collaboration:** "[When our team first met] we sat around for two or three hours and we just talked about why does [your discipline] do it this way? And we were comparing notes. You guys do this and I've done that…but am I doing it right? That sort of thing."	Challenges	19
	Collaboration	10
	Meeting strategies	16
	Opportunities	11
3) Researcher-Stakeholder Partnerships **Strategies:** "Different strategies are required for different situations, different stakeholders, even different times within a project. There is no one-size-fits-all solution."	Partnership interests	36
	Strategies	38
	Transformations	24
	Ethics and Power	9
	Conflicts	20
4) Stakeholder engagement **Stakeholder agency:** "If you hoped to change the world, my guess is there are some considerable advantages to working with stakeholders and the reason is that nothing is going to change unless they change."	Stakeholder agency	25
	Funding	4
	Challenges	39
	Defining stakeholders	41
	Why engagement	25

Table 2.1. continued.

Theme	Sub-theme	# interviews coded
5) Social Learning	Workshop Structure	23
	Workshop Content	37
	Reflexivity	6
	Learning	20
Workshop Content: "Citizen science being very much connected with some of the work that we're doing. But each different subject area or field calls it something different. So it would be neat to try to bring some of that in--making those connections between cooperative extension work, citizen science, knowledge-action, sustainability research."	Hopelessness & Frustration	10
	Interpersonal relationships	6
	Interview as opportunity	7
	Responsibility	8
	Personal connection	18
	Science & University culture	9
	Risk taking	2

2.5.2. Rules: Typologies, Involvement, Length, Frequency, and Technologies

In the interviews, participants described stakeholders following a distinct typology, starting at the level of individuals and teams and moving outwards to include institutions like SSI, UMaine and NSF; community groups; society and future generations; and the more-than-human-world (Table 2.2). This nested typology is summarized by one participant:

> *The first set of stakeholders are the people I work with, the team itself. And then other folks who are involved with the SSI project, and then other folks that are complementary to the University, institutional functioning. I didn't anticipate thinking of them as stakeholders, but you kind of have to. Concentric circles outward is how I think of stakeholders. To be human means that you live on this earth, you breathe air, and drink water. Those are the stakeholders that I see that are…human and more-than-human.*

When we tested the typology and levels of involvement in the survey, participants reported high levels of involvement with municipal officials (M=2.8, SD=1.1), state agencies (M=2.8, SD,=1.0) and non-profit organizations (M=2.7, SD=1.0). Our results on communication frequency demonstrated that researchers were in contact with key stakeholders on a monthly or quarterly basis.

2.5.3. Resources: Decision Making, Collective Communication Competencies, Identities and Motivations, and Social Learning

We identified five primary decision making models as identified by relative interview coding frequency, including consensus based (63%), problem-project specific (49%), core group involving 3-4 people (49%) , single person decision maker (34%), and no decision making structure (2%). The single person decision making strategy is exemplified in the quote

> *I think [this team] is very much doing that, of having one person drive things. And also getting into this kind of interesting time issue in that, some of the teams have a sense that "We'll do the science that needs to be done and then we'll share the science" and they don't yet have a feeling for when that is problematic.*

Many teams described more than one decision-making strategy. In the following quotation, a participant described both consensus-based and project and problem specific models:

> *We get together for meetings or through email, come to a consensus usually. It is pretty driven by that rather than one person making a decision, unless it is something silly and small. And the reason for that is because it's a combination of divergent interests so not any one person can [make all the decisions]. Remote sensing people are much better at making decisions about remote sensing than I am, as an example.*

Interviews and participant observations revealed that teams using single person decision making are not having as much success as those team that use more participatory

approaches, when success is measured by individual satisfaction and progress towards stated goals.

Team members also reported a high degree of communication competence (Table 2.3). The mean CCC scale was 4.12 (SD, 0.63, α=0.69). The strongest correlations were among the inclusion of diverse ideas in the project and decision making (r=0.81) and CCC (r=0.66) respectively. Mutual understanding was also strongly correlated with CCC (r=0.64). In a series of cross-tabulations that examined differences in assessments of decision making, CCC, and outcomes among faculty and graduate students, by institution, and by disciplinary area, the only significant difference was in the level of agreement with decision making involvement among faculty and graduate students, with grad students expressing less involvement in decision making (n=65, x^2= 13.087, df=1, p<0.001).

Table 2.2. Degree of participation by stakeholder typology and category, level of involvement (1=Not involved, 2=Somewhat involved, 3=Involved, 4=Very involved), length of collaboration, frequency of contact, and communication media (all other includes video, phone and/or conference call, technical reports and/or newsletters, project or research website, and blogs). Most involved stakeholders (n=5) highlighted.

		Level			**Length**		**Communication Frequency**		**Media** (%)			
Stakeholder Typology and Category		N	Mean	SD	N	Mode	N	Mode	Total	Face	E-mail	All other
More than human world		59	2.5	1.3	32	10+ yrs.	34	Don't know	~	~	~	~
Society	Future generations	72	2.3	1.1	40	10+ yrs.	44	Don't know	~	~	~	~
Institution:	NSF/EPSCoR	71	2.4	1	46	1-3 yrs.	50	Annually	55	11	24	66
	SSI	77	**3.0**	0.9	63	1-3 yrs.	69	Monthly	108	36	43	21
	University	73	2.1	1	41	10+ yrs.	43	Quarterly	65	39	46	15
	Dept. colleagues	82	2	1	46	10+ yrs.	45	Monthly	88	49	49	2
Team & Community:	Federal agencies	79	2.1	1.1	42	10+ yrs.	42	Quarterly	68	21	43	37
	Individual citizens	82	2.6	1	62	10+ yrs.	65	Quarterly	35	54	29	17
	K-12	76	1.6	0.9	27	10+ yrs.	30	Never	92	37	35	28
	Municipal officials	82	**2.8**	1.1	61	1-3 yrs.	63	Quarterly	19	74	16	11
	NGOs	78	**2.7**	1	59	10+ yrs.	62	Quarterly	99	41	37	21
	Private sector	79	2.3	1	53	1-3 yrs.	54	Annually	83	40	35	25
	State agencies	80	**2.8**	1	60	10+ yrs.	63	Monthly	111	33	43	2
	Tribal communities	78	1.5	0.9	18	3-5 yrs.	18	Don't know	17	47	35	18
	Cooperative Extension	82	1.8	0.9	33	1-3 yrs.	36	Monthly	57	37	47	16
Team	Researchers on SSI	79	2.5	1	59	1-3 yrs.	62	Weekly	105	49	47	5
Individual	Self	83	**3.7**	0.7	53	10+ yrs.	68	Daily	41	71	24	2

Researchers also described several different identity-related dynamics. The following quotation demonstrates one researcher's identity as a sustainability scientist and how this relates to her motivation to engage in collaborations across disciplines and with stakeholders:

> *In my view, you go back to some of the early writings by Bill Clark, Nancy Dickson, even Cash to a certain extent, where they say, "What is sustainability science? Well, we're going to look at the dynamics of coupled natural human systems. We're going to do work that is problem-oriented. And we're going to co-produce knowledge with stakeholders." So, to me it's part of the definition. It's what distinguishes sustainability science from some other form of science. It's reconceptualizing science or how we do research.*

This participant described the norms associated with sustainability science and then integrated these norms into her own identity as a researcher. The quantitative PCA results demonstrated this pattern of motivation and identity across SSI more broadly. The PCA demonstrated six factors in researcher motivations and identities related to stakeholder engagement, including sustainability scientist identity (e=6.14, VAR= 29.25, α=0.83), need for boundary spanning (e=2.04, VAR=9.71, α=0.78), and service to society (e=1.76, VAR= 8.40, α=0.66) (Table 2.4). Other motivation factors included funding support and grant requirements; commitment to stakeholder rights and relationships; and departmental obligations.

In the interviews, participants described specific identity-related issues in stakeholder engagement and interdisciplinary collaboration, including understanding differences in terminology and language use, personalities, a sense of fear, and loss of control over setting the research agenda. This quote demonstrates the latter point, when a researcher expressed fear about working with stakeholders:

> *And it's pretty frightening too, because there's a loss of control and stakeholders want questions asked that are really tough to answer. It's also being forced to try*

> *and tackle questions that we have been avoiding. As scientists you're trained to have perfect answers and if you don't have a perfect answer, don't say anything. To engage with the stakeholder questions, you're going to have to be willing to produce partial answers…and that's almost a complete mind change.*

Researchers described the influence of material resources like lack of time and constraints in the tenure review system. Despite these resource-related challenges, survey results demonstrated that 89% of respondents indicated that they intended to continue working with stakeholders after the completion of the grant cycle, and 69% of respondents felt that they were getting better at stakeholder engagement.

Table 2.3. Correlations among process variables, including decision making and CCC, and outcome variables including mutual understanding of goals, idea inclusion, and satisfaction with stakeholder engagement. Participants were asked to rate their level of agreement or disagreement with statements (1=strongly disagree and 5=strongly agree).

	N	Mean	SD	Mutual Understanding (Mean=4.1, SD 1.03)	Ideas Included (Mean=4.3, SD, 0.78)	Engagement Satisfaction (Mean=3.7, SD, 1.1)
Decision Making: I am very involved in the decision making on my team.	82	4.01	1.09	0.50**	0.81**	.25*
CCC Summative scale (α=0.69)	82	24.71	3.78	0.64**	0.66**	0.45**
CCC Scale with variables	82	4.12	0.63	~	~	~
1. My team members communicate well with each other.	82	4.10	0.98	0.62**	0.52**	0.39**
2. My team rarely shows respect for diverse opinions.	82	1.88	1.24	-0.17	-0.03	-0.01
3. My team laughs or uses humor frequently.	82	4.28	0.82	0.36**	0.33**	0.33**
4. My team rarely discusses outcomes.	82	1.99	0.99	-0.43**	-0.51**	-0.39**
5. My team actively works to build a common language.	82	3.90	0.87	0.50**	0.48**	0.38**

**Correlations significant at the 0.01 level (2-tailed).
*Correlation significant at the 0.05 level (2-tailed).

Table 2.4. Principal Components Analysis (PCA) of researcher motivations for stakeholder engagement. Participants were asked to rate how much they agreed or disagreed with the following statement: "I was motivated to engage stakeholders in my SSI project(s) because . . ."

Rotated Component Matrix[1]

	Factors						
	1	2	3	4	5	6	Communality
1. Sustainability Scientist Identity, α=0.83							
…they will help me be the kind of scholar I want to be.	0.74	0.20	0.15	0.09	0.06	0.13	0.63
…it makes my research relevant and locally appropriate.	0.71	0.20	0.18	0.02	0.17	-0.11	0.62
…I want to help empower stakeholders to have a voice in the research.	0.67	0.29	0.14	0.09	0.30	0.19	0.69
…the partnership(s) ensure stakeholders' and researchers' needs are met.	0.52	0.45	0.32	-0.16	0.09	0.12	0.63
2. Boundary Spanning, α=0.78							
…their involvement in this research is more likely to influence individual and/or institutional action.	0.28	0.76	0.13	0.08	-0.07	0.03	0.69
…I enjoy learning from people with different types of knowledge.	0.22	0.71	-0.02	0.04	0.24	-0.12	0.63
…it will help ensure the sustainability of the issue(s)/resource I study/care about.	0.49	0.65	0.24	-0.01	-0.24	-0.01	0.78
…it will help resolve conflict among stakeholders.	0.06	0.59	0.16	-0.04	0.21	0.27	0.50
…of the satisfaction I experience from taking on interesting challenges.	0.38	0.49	0.08	0.15	0.40	0.04	0.57
3. Service to society, α=0.66							
…I feel like I've failed if my research isn't used by society.	0.21	0.11	0.81	-0.22	0.10	-0.03	0.77

Table 2.4. continued.

…I believe the issue I study is in a state of crisis.	0.28	-0.08	0.67	0.18	-0.12	0.10	0.59
…it will help me educate and train citizens, a central goal in my work.	0.35	0.17	0.55	0.18	0.15	0.01	0.51
…my colleagues brought them into the process.	-0.16	0.33	0.52	0.28	0.01	0.10	0.49
…I want to be recognized by my peers as doing this work well.	0.01	0.37	0.50	0.04	0.30	0.26	0.55
4. SSI Funding Opportunity, α=0.62							
…SSI requires me to include them.	0.09	-0.07	-0.06	0.89	0.09	0.10	0.82
…of the funding SSI provides.	0.28	0.13	0.15	0.75	-0.30	-0.13	0.78
…I have nothing to lose.	-0.28	0.11	0.28	0.51	0.20	0.14	0.49
5. Rights and Relationships, α=0.65							
…I don't have the right to exclude stakeholders from processes that may impact them.	0.18	0.05	0.14	-0.03	0.85	0.14	0.79
…I really enjoy working with stakeholders.	0.48	0.25	-0.04	0.02	0.54	-0.07	0.59
6. Departmental, α=0.62							
…my department required my participation.	-0.11	0.03	0.05	0.18	0.00	0.87	0.80
…it helps me bring on more graduate student	0.27	0.07	0.10	-0.10	0.12	0.81	0.77
							Totals
Eigenvalues	6.14	2.04	1.76	1.47	1.18	1.10	13.69
Percent of variance	29.25	9.71	8.40	6.98	5.63	5.22	65.20

[1]Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, 0.73; Bartlett's Test of Sphericity= 638.54, df 210, n=82.

2.6. Discussion

Our results highlight the rules and resources that structure communication on teams and how these influence outcomes. Further our results demonstrate how studying communication can help identify ways to make strategic changes within collaborations to promote alignment among degree and quality of participation and intended outcomes across scales. Here we elaborate these points and put our results in conversation with the communication systems framework (Figure 2.1). In response to our first research question, which called for a descriptive analysis of communication on teams, we identified a set of rules and resources that influenced social interactions. In an above quote a participant described inclusive decision making as a way to grapple with the complexity of combining diverse interests and skills, like remote sensing, in the collaboration. This participant echoed many others who said that the single person decision making model did not allow the integration of diverse perspectives in research. Our qualitative and quantitative results clearly demonstrate that decision making as a space of interaction is an important process variable on teams.

The concepts of recursivity and resilience help us understand why lack of access to decision space may be a problem. Adaptive capacities, a resilience concept, emphasizes how a diversity of perspectives and opportunities for social learning help groups identify what to sustain and how to transform when they need to (Folke et al., 2010; Walker et al., 2004). Recursivity assumes that what happens in parts of a team will begin to run throughout the system (Giddens, 1984). When teams do not create a space in which diverse perspectives can be brought to the table to promote opportunities for remote sensing people to explain the value of their work or graduate students to inform

the stakeholder engagement based on prior life experiences, teams constrain their learning opportunities (Graybill et al., 2006). They also limit who contributes to the development of sustainability as a societal norm and they undermine participatory democratic engagement (Deetz, 2008).

Another example of how rules and resources structure interactions and influence emergent meaning and norms is evident in a quote from Table 2.1, when a researcher described meeting strategies in initial team collaboration stages. Meeting face-to-face and talking for two hours provided opportunities to ask, "Am I doing this right?" What is "right" is socially defined by the team as an emergent norm. The rule of meeting face-to-face and talking about differences created conditions for subsequent interactions. Although this team met face-to-face, if they did not also have an inclusive decision space and high CCC, their interactions would not likely promote mutual understanding or inclusion of diverse ideas. The team's use of active listening in "comparing notes" and reflection about differences in disciplinary approaches demonstrated high CCC (Thompson, 2009). This approach also allowed the identification and negotiation of frame differences which has been shown to be important in these types of collaborations (Dewulf, François, Pahl-Wostl, & Taillieu, 2007). What matters is not one decision making approach or collaboration strategy over another, but attunement to how rules and resources create conditions for what becomes possible in collaborations and how strategic transformation may promote different outcomes (Poole & McPhee, 2005).

Understanding motivations and identities allows identification of resources that may influence interactions and outcomes. The researcher who described the integration of sustainability science as a definitional norm into her own identity provides a clear

example of Giddens' (1984) discussion of how norms recursively guide micro-practices and macro-structures. Opportunities for social learning, like the many SSI presentations and workshops in which participants learned about the work of Dickson and others, helped promote the integration of meaning and norms into identities. As this participant demonstrated, changing how she saw herself as a scholar has implications for reconceptualizing science and how we, collectively, encourage more democratic models of science in society.

We take these results to the communication systems framework to trace relationships among process and outcome variables (Figure 2.1). We begin with decision making as a team-based resource that influences the micro-practices in which participants define research questions and develop methodologies. The researcher who described how her team figured out how to include remote sensing as a research technique used inclusive decision making as a resource coupled with the rule of meeting face-to-face and e-mail to work through differences in methods and disciplinary language. The structuration of these micro-practices set them on a course to produce specific outcomes, including mutual understanding across disciplines (collaborators learned more about remote sensing and its value), the inclusion of diverse ideas (remote sensing people found a way to integrate their skillset within a diverse team), and progress toward stated goals (publishing research products, educating students, promoting the use of remote sensing in communities).

At the same time, micro-practices flow into macro-structural patterns. Rules and resources structure how individuals come to see themselves as part of a team and how teams become interdisciplinary with effective stakeholder engagement practices.

Individual and team patterns run through the organization, creating a system characterized by a suite of interdisciplinary teams working towards collective goals and developing multiple sustainable solutions with the attendant implications for resilient and sustainable SESs. Collective work on SSI connects with efforts across the country in sustainability science and PPSR to enhance democratic engagement with science. This framework provides the initial stages of an empirical model to trace these relationships qualitatively and quantitatively by identifying key process variables and linking these with relevant outcomes.

2.7. Conclusion

While the rules and resources we identified in SSI will not be exactly the same in other contexts, paying attention to these general dimensions of communication on teams allows collaborators to describe the complexity of communication as a first step in making process improvements. Based on our results, we argue that the most important social dynamics to which program leaders and collaborators should attend are the resources: decision making space, CCC, identities on teams and within organizations, and opportunities for social learning. Our correlation results demonstrated that inclusive approaches to decision making and CCC created the necessary space of interaction to promote the incorporation of diverse ideas, mutual understanding of goals, and to a lesser extent, satisfaction in the stakeholder engagement process. However, there may be differences in perceptions of these social resources among participants in collaboration, as was demonstrated among faculty and students. Attending to the difference in perceptions and expectations within the partnership may be crucial to align degree and quality of participation (Hutchins, Lindenfeld, Silka, Leahy, & Bell, 2011).

Our contribution to the framework for deliberate design offers strategic process variables to which collaborators can attend to improve alignment among how collaborators want to participate (degree) and what collaborators seek to achieve at multiple scales (quality) (Shirk et al., 2012). If a team is not making progress toward stated goals, individual members express dissatisfaction with engagement, and/or collaborators feel they do not understand one another, looking at the rules and resources that influence interactions will help identify ways they may be able to change. Collaborators could examine their decision making to ask: do all participants exhibit agency in research design, including co-determination of the degree and quality of the participation? Do they have a space to articulate what they bring to the table and why it may be important to outcomes? These questions demonstrate how ST and the rules and resources we identified in SSI may become a "sensitizing device" in collaborations (Giddens, 1984).

This research points towards a need for expanded research that addresses stakeholder perspectives and power. We restricted our research to faculty and graduate students because this is a key gap in the literature. However, understanding these dynamics from the stakeholder perspective is a crucial next step to refine the empirical model and generate new process considerations. We also observed interactions among people of different genders, disciplinary backgrounds, and academic status (i.e. faculty and student) that revealed a need for a more direct investigation of power in social interactions (Ashcraft, 1998; Macmynowski, 2007), which is possible using structuration theory.

Future studies should thus consider using structuration theory to understand and improve interactions within teams characterized by interdisciplinary collaboration and stakeholder engagement. Inclusive decision making creates a space of interaction in which team members can develop mutual understanding of goals, include diverse ideas in project formation, and make progress towards specific outputs, like the development of research products, legislation, and changes in skill, knowledge and identity. At the same time, the emergence of meanings, norms, and power move across scales to create patterns of order on teams and in the broader constellation of social-ecological arrangements. Systems theories of communication offer an important contribution to understand and improve social interactions to enable and guide the intended outcomes and emergent patterns from our complex sustainability science collaboration.

CHAPTER 3

WORKING THE TIDES: BUILDING COLLABORATIVE CAPACITY IN FRENCHMAN BAY

"But I think there has to be a mutual thing there, that. The Bay needs to get together and discuss it. But they have to realize, you cannot control the tides.

'Time and tide and baby wait for no man.' That's an old saying."

– Roger, mussel harvester in Frenchman Bay

3.1. Introduction

The Frenchman Bay Partners (hereafter Partners) is a group formed in response to the tides: to what the tides bring in, to what they provoke, to how they change. We as Partners are individuals who work the tides in different ways: some of us fish and dig clams; others write grants to buy land and make land use plans; still others wade out into the water to plant eel grass and measure water temperature. In doing these things, the Partners have come to understand that collaboration in the Bay would help promote social and ecological resilience, a direction we have adopted as organizational mission. To achieve this *resilience thinking* mission, we use a conservation action planning process as a way to identify what to sustain in the Bay and how to get there (Folke et al., 2010; Salafsky, Margoluis, Redford, & Robinson, 2002). In this way, conservation action planning constitutes a way to organize planning and action in response to the changing tides.

The Partners' intention to create a resilient and sustainable future in the Bay through a collaborative planning process invites the question: how do we work with each other and what emerges from interactions? More specifically, how does communication

influence the conservation action planning process and the realization of the Partners' organizational mission for resilience and sustainability? In what ways could communication be improved for enhanced sustainability and resilience?

Our primary finding from nearly three years of ethnography with the Frenchman Bay Partners is that our collective capacities for conservation action planning depend on and can be enhanced by *working the tides*. Working the tides is a metaphor that operates on symbolic and material levels, which we explain and clarify in greater depth below (Barad, 2007; Druschke, 2013; Whatmore, 2006). While this metaphor comes from our unique dwelling in the Bay, we also see it in the way that Hawhee (2005) explains metaphors as "a term for interchange or exchange" derived, appropriately in our case, from the Greek word for the passing phases of the moon (p. 82). Working the tides as metaphor is a boundary object too, an entity that means different things to different people involved in this writing and research but that helps us coordinate and communicate across difference and produce new understanding and relationships (Star & Griesemer, 1989; Wilson & Herndl, 2007).

Barad (2007) uses metaphor as a way to "be evocative of the sedimenting process of becoming" and goes on to note that metaphor "is not to be taken literally as representation; rather, it is offered as an evocation and provocation to think with" (p. 181). In our use, *thinking with* working the tides is about attuning to where our capacities come from; how difference promotes conflict and creativity; and how, by adopting specific process commitments, we can respond to and work with change. The Partners worked the tides in their planning process by checking the tide charts; creating strategic interventions to grow capacity; using boundary objects to navigate; and by making the

commitment to keep coming back. As shown in the opening quotation, the tides participated with, enabled, and constrained us as the Bay got together to create a plan. For us, working the tides became a point of attachment as we worked towards sustainability in a dynamically enfolding world, a world in a perpetual mode of becoming (Barad, 2007; Whitehead, 1978).

We draw from a diverse set of literatures that help us explore, explain, and strategically intervene in the Partners' collaboration. These include sustainability science, resilience thinking, boundary work, conservation action planning, and systems and material theories of communication. Our integration of these literatures comes from an interest in understanding the multiple dimensions of the Partners' work: the kinds of questions they asked in the formative stages of the research design; the questions that emerged in the process of making observations; and how this conservation action planning process promoted sustainability. This integration also comes from previous work that identifies a need to bring interdisciplinary communication theories to sustainability science and boundary work for enhanced research and practice across fields (Lindenfeld et al., 2012; McGreavy et al., 2013).

We begin this essay with a brief review of resilience and sustainability science (Folke et al., 2010; Kates et al., 2001); boundary work (Clark et al., 2011; Jasanoff, 2004); and conservation planning (Salafsky et al., 2002; Schwartz et al., 2012). We then describe systems (Monge, 1977; Thompson, 2009) and material theories of communication (Barad, 2007; Whatmore, 2006). Briefly, communication as a system largely focuses on symbolic interactions among human beings and the meaning, norms, and relationships of power that emerge from and continually structure those interactions.

Materiality broadens the view of system to vibrant assemblages composed of humans and more than humans (Bennett, 2010) and the dynamic affectability that enables capacities (Barad, 2007; Rickert, 2013; Stormer & McGreavy, Under review; Whatmore, 2006). After setting up our theoretical framework, we describe our ethnographic methods with the Partners in which we observed and supported communication and capacity building. We integrate our results and discussion and use qualitative themes identified in our analysis that relate to how we worked the tides. We conclude with recommendations for how other groups using conservation action planning or similar boundary work strategies may adopt an orientation towards working the tides in their collective striving for sustainability.

3.2. Resilience, Boundary Work, and Conservation Planning

Sustainability and resilience thinking serve as a starting point for research with the Partners in conservation action planning (Folke et al., 2010; Kates et al., 2001; Walker & Salt, 2006). Sustainability is a process in which diverse actors come together to identify ecological and social values and, when necessary, find ways to adapt and transform to maintain and realize those values. In a marine-based watershed, values and outcomes may include clean water, as measured by turbidity and oxygen levels; healthy populations of eel grass, as defined by historic acreage; productive intertidal mudflats, as measured by clam landings and available harvest area; the return of diadromous fish to specific rivers within the watershed; among others. Approached in this way, sustainability is both process, a striving together, and the values and outcomes (re)produced through process.

Sustainability science adds the commitment of systematic observations and peer review to sustainability as process, outcomes, and values. This is a problem-focused approach to working across disciplines and with diverse stakeholders to inform decisions about activities such as how to remove pollution from water columns and intertidal mudflats; restore eel grass communities; and promote sustainable working waterfronts (Clark & Dickson, 2003; Kates et al., 2001). In sustainability science, different ways of understanding the world provide opportunities for new knowledge, better decision making, and stronger relationships between science and society (Jahn et al., 2012; Kates et al., 2001).

Resilience thinking is a related yet distinct perspective that encourages attention to adaptive capacities (Berkes & Ross, 2013; Folke et al., 2010; Goldstein, 2012; Walker & Salt, 2006). These capacities include the ability to learn from one other (Goldstein, 2012; Pahl-Wostl, 2006; Tschakert & Dietrich, 2010); create unique and regional identities (Smith, Moore, Anderson, & Siderelis, 2012); develop loosely connected social networks and polycentric governance structures (Berkes, 2007; Bodin & Prell, 2011; Pahl-Wostl, 2009); and promote ecological memory (Davidson-Hunt & Berkes, 2003; Goldstein, 2008), among other attributes. Adaptive capacities promote social ecological systems' abilities to respond to change to maintain or transform the system depending on desired goals (Folke et al., 2010; Walker et al., 2004).

At the heart of sustainability science and resilience thinking is a commitment, through different forms of interaction and collaboration, to make the world a better place for present and future inhabitants. Central to collaboration is *labor*, or the work required to understand and find ways to negotiate myriad difference. Sustainability science draws

from discussions of boundary work in science and technology studies to address the many dimensions of this labor (Clark et al., 2011; Guston, 2001; Jasanoff, 1987; Star & Griesemer, 1989). In the following sections, we explore the role of organizations and objects in boundary work and how conservation action planning is a form of boundary work. We then turn to systems and material theories of communication to expand on discussions of resilience, sustainability science, and boundary work to show how communication offers important insights for this world-making work (Lindenfeld et al., 2012; McGreavy et al., 2013).

3.2.1. Boundary Work: Organizations and Objects

Sustainability-focused collaborations that bring diverse actors together require individuals to negotiate many different types of boundaries. Boundary work explores how social difference is produced and changed through these collaborations. Boundaries may be understood as the emergent interfaces that occur among individuals with unique identities, knowledges, geographies, and other characteristics that (re)create difference (Clark et al., 2011). Boundary work focuses on a combination of spanning and management activities (Clark et al., 2011); the use of multiple types of boundary objects (Star & Griesemer, 1989; Wilson & Herndl, 2007); and the development of organizations, like the Partners, that can move flexibly across boundaries (Guston, 2001; Parker & Crona, 2012).

A central idea of boundary work is that tensions arise at the interface between communities with different perspectives. If an impermeable boundary emerges at the interface, no meaningful communication takes place across it. However, if the boundary is too porous, personal opinions mix with validated facts, science gets mixed

with politics, and the special value of research-based knowledge fails to materialize (Clark et al., 2011). Boundary organizations are groups that are uniquely positioned to help facilitate communication and collaboration and to maintain and transform boundaries in different ways (Guston, 2001; Parker & Crona, 2012). Importantly, these groups are not neutral. Instead, boundary organizations participate in an inherently political process of coordinating communication in ways that enable collaboration but that also produce social order and reproduce difference (Jasanoff, 2004). In cases where boundary organizations facilitate the use of science in policy decisions, a key role for these organizations is to work both sides of the boundary to create situations where science can "talk" to policy but also where science remains recognizable as a distinct domain of knowledge production (Guston, 2001; Jasanoff, 2004).

Organizations that attempt to work across and still maintain difference may turn to boundary objects to enable their activities (Clark et al., 2011; Star & Griesemer, 1989). In one influential case study, Star and Griesemer (1989) describe the use of boundary objects in methods standardization across disciplines and institutions in the development of a natural history museum. They argue that boundary objects must be "plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites." Further boundary objects constitute a key process, not simply a fixed tangible entity, that participates in "developing and maintaining coherence across intersecting social worlds" (Star & Griesemer, 1989, p. 393). Boundary objects are thus active agents in the changes that occur within co-production.

Thus, at one level, boundary objects help coordinate a diverse assortment of practices through which a range of actors may come together to develop shared understanding. On a second level, boundary objects inhere differentially according to the situated contexts of those seeking to cross the boundary and they actively create spaces that enable changes in relationships and identities (Star & Griesemer, 1989; Wilson & Herndl, 2007). In other words, boundary objects create opportunities for individuals to communicate across differences and they are also responsive to and can reproduce differences. The term "object" may imply a type of fixity but it is important to emphasize that these are objects as ongoing processes, not entities that carry with them stable meanings to improve the transfer of information from one context to another. Co-production is not just about getting stakeholders together to make new and better knowledge from diverse interests and experience. Co-production is about making world in these interactions and boundary objects participate in this production (Star & Griesemer, 1989; Wilson & Herndl, 2007).

3.2.2. Conservation Action Planning as Boundary Work

Conservation action planning provides a distinct approach to boundary work. Conservation action planning follows a set of open standards developed by the Nature Conservancy, World Wildlife Fund and others in the Conservation Measures Partnership for Success (Salafsky et al., 2002). This approach uses conceptual modeling to help participants identify and prioritize sustainability values or "targets" (Margoluis, Stem, Salafsky, & Brown, 2009; Salafsky et al., 2002). These open standards guide the use of conservation action planning through distinct stages including conceptualizing the conservation context, planning actions and monitoring strategies, implementing actions,

adapting plans and actions based on new information, and sharing learning in the process with others (Salafsky et al., 2002). These stages integrate with a software called Miradi which guides participants through stages in which they identify human and ecological targets, describe threats to targets, prioritize strategies to address threats, and create chains of action to reach conservation planning goals. For example, the Partners identified the ecological and economic health of intertidal mudflats as one of their primary habitat targets. Leaky septic systems are a major threat to mudflats. A strategy to address this threat is to develop capacity in the watershed for shoreline surveys to identify pollution sources. A goal related to this strategy is to find ways to fix these pollution sources and open all 610 acres of restricted clam flats in Frenchman Bay.

While this process has been used by conservation organizations throughout the world for more than a decade, there is very little research about this planning process and none that examines it as form of boundary work or the communication that occurs within this work (Margoluis et al., 2009; Schwartz et al., 2012). Organizations, like the Partners, may function as boundary organizations in their use of this planning method. Further, Miradi as a tool may be a boundary object that helps shape knowledge co-production (Clark et al., 2011; Star & Griesemer, 1989). A focus on communication within this planning would promote important insights into the process, outcomes, and how these may be improved through strategic interventions.

In sum, boundary work highlights the role organizations and objects play in knowledge co-production processes to address complex problems. A group like the Partners has a unique role to play in coordinating diverse boundary work practices, including negotiating how knowledge co-production is about making new knowledge and

also creating the social capacity to use that knowledge (Jasanoff, 2004). Communication has much to contribute to understanding complex interactions and what emerges from conservation action planning as a knowledge co-production process. Systems and materiality theories directly address the concept of boundaries: how boundaries form, how they may be reconfigured, and how they change through time. As we show in the following section, these theories offer important insights for sustainability, resilience, and boundary work (Lindenfeld et al., 2012; McGreavy et al., 2013).

3.3. Communication as System

By starting with resilience and by using conservation action planning as a conceptual modeling approach, the Partners implicitly identified their view of the world as a system. This view influenced the development of questions that invited systems theories of communication and methods that helped us explore and understand relationships from this vantage point (Daniels & Walker, 2001; Ramage & Shipp, 2009; Thompson, 2009). However, as the collaboration advanced, we began to recognize other dynamics and turned to perspectives that would help us understand and explain these, including theories of materiality (Barad, 2003; Bennett, 2010; Rickert, 2013; Whatmore, 2006). Systems and materiality theories may be closely aligned as they both focus on interactions and emergence. Further, some materiality theorists explicitly connect their work with complex systems theories (Coole & Frost, 2010; Rickert, 2013). As we demonstrate, a key difference between systems and materiality is in how these theories approach the basic understanding of what it means to be human and capacities for language and other activities. Bringing these theories together provides a richer and more entangled perspective on communication, boundaries, and sustainability (Barad, 2007).

3.3.1. What is a System?

Systems perspectives *writ large* rely on four foundational assumptions: wholeness, self-regulation, adaptation, and nestedness (Monge, 1977). Monge (1977) elaborates "the world viewed as systems consists of interlinked sets of components hierarchically organized into structural wholes which interact through time and space, are self-regulating, yet capable of structural change" (p. 20). Systems are comprised of parts that together foster an emergent property that is greater than each constituent part. Interaction between the parts and nested levels of organization produce emergent meaning, norms, and power in communication and these together influence subsequent interactions (Monge, 1977). Paying attention to interactions allows analysis of how communication influences the development of different types of outcomes, like how people with different backgrounds produce knowledge together; who is invited in as a stakeholder and how they participate in the planning process; and how these interactions influence what becomes prioritized as sustainability values.

3.3.2. Interdisciplinarity and Public Participation as System

The Frenchman Bay Partners had two distinct arrangements. First, there was a core team of partners who initiated the conservation action planning and comprised the early steering committee to advance the plan. Second, there was a network of partners, such as clam diggers, municipal officials, fishermen, real estate agents, and others with varying degrees of participation. Given these dynamics, two complementary yet distinct systems literatures were relevant to this study, namely communication in teams and organizations (Morgan, 1997; Thompson, 2007, 2009) and communication in public participation and stakeholder engagement processes (Daniels & Walker, 2001; Norton,

2007; Senecah, 2004). These literatures draw from interdisciplinary orientations to systems such as complex systems, cybernetics, and soft and critical systems theories (Ramage & Shipp, 2009).

The study of communication on interdisciplinary teams focuses on interactions that promote or inhibit the success of the team. Thompson (2009) describes this focus as one where "communication structures and processes are at the root of understanding how interdisciplinary teams communicate and collaborate to address issues that are important to society and the scientific community" (p. 9). Different types of interactions condition two primary outcomes, including 1) efficacy in achieving the task-related goals and 2) the ability to maintain interpersonal relationships (Thompson, 2009). Observing interactions over time allows the identification of those interactions that promote goals and those that inhibit desired outcomes (Thompson, 2009). These types of interactions vary depending on the context but may include practices such as demonstrating presence, using humor, and challenging statements in a positive manner. The use of sarcasm, blatant boredom, and power struggles are interactions that can inhibit efficacy and interpersonal relationships (Thompson, 2009). Communication research that observes interactions and outcomes through the lens of collective communication competencies (CCC) can feed back into collaboration processes to help promote progress towards identified goals for the collaboration (Morgan, 1997).

Discussions of public participation similarly take up systems to understand and, when possible, improve communication interactions for particular outcomes, such as in environmental policy development (Daniels & Walker, 2001; Norton, 2007; Senecah, 2004). Where CCC highlights individual interactions that influence how people achieve

tasks and maintain relationships, public participation calls greater attention to structural dimensions that influence interactions and what emerges from these (Norton, 2007; Senecah, 2004). Senecah's (2004) Trinity of Voice (TOV) framework is especially useful for calling attention to how structure influences process. The TOV framework addresses how communication influences public participation. In her view, effective public participation processes rely on adequate access to information, standing in participation processes, and influence over decision making. This framework has been especially useful in natural resource planning and environmental policy contexts (Norton, 2007; Thompson, Forster, Werner, & Peterson, 2010; Walker, Senecah, & Daniels, 2006).

3.3.3. Systems, Boundaries, and Sustainability

How does approaching communication as a system contribute insights to resilience, sustainability science, and boundary work? Systems theories of interdisciplinary collaboration and public participation processes highlight two key communication dimensions. First, the ways in which we communicate with each other matter for who participates; how they interact; and what teams, organizations, and other participation processes produce from collaboration (Senecah, 2004; Thompson, 2009). The many dimensions of our interactions promote the emergence of meaning, norms, power and other outcomes and these continue to recursively influence emerging social order (Giddens, 1984; Norton, 2007). Second, systems theories of communication help us understand difference not as a fixed and stable state of being but as a continual mode of becoming. The boundaries that organize difference are always created and recreated through interactions. In sum, communication as system helps us understand key features

of interactions, structures that delimit participation, boundaries, and outcomes that emerge. Further, systems theories can also promote strategies to improve efficiency, relationships, and help groups make progress towards sustainability goals. In the following section, we broaden this view of interactions, structures, participation, and interactions to include important insights from theories of materiality.

3.4. Communication and Materiality

Theories of materiality help us explore questions related to the participation of materials, like the tides, and how these influence collaborative capacities (Barad, 2007; Whatmore, 2006). As seen in the above discussion and in the previous chapter, systems theories generally approach materials as resources that are mobilized in interactions and not as actors themselves. Studies of materiality shift the attention of materials as being mobilized to how materials participate in the production of capacity. These studies often include a focus on how capacities arise through bodies, which are to be understood not as fixed and stable objects but bodies as entanglements (Barad, 2007). All bodies, not just human ones, are key sites in studies of materiality (Whatmore, 2006).

In material approaches, bodies intersect with but are not completely driven by language in the production of meaning in the world (Barad, 2007; Bennett, 2010; Whatmore, 2006). Whatmore (2006) demonstrates this distinction when she calls for a shift from meaning to affect which "reopens the interval between sense and sense-making, and multiplies the sensory dimensions of acting in the world and the milieux of inter-corporeal movement" (p. 604). Paying attention to bodies as they move and intermingle broadens perspectives on agency and how capacities for action and sets of activities, like conservation action planning, emerge. The focus on multiple bodies and

modes of encounter through sensory and sense-making performances invites strategies of enquiry that "attend closely to the rich array of the senses, dispositions, capabilities and potentialities of all manner of social objects and forces assembled through, and involved in, the co-fabrication of socio-material worlds" (Whatmore, 2006, p. 604). From this vantage, *working the tides* becomes an embodied performance where the human is one in a vibrant assemblage of participants (Bennett, 2010). It is through an assemblage of diverse participants that the world-making-work of conservation action planning can occur.

3.4.1. Diffraction, Swirls, and Intervention

Thus, materiality focuses on myriad bodies in spaces of interaction and the kind of world these bodies co-produce. Barad's (2007) discussion of diffraction adds another layer of depth to these interactions and unfolding patterns of action. Diffraction refers to the effect when any kind of wave meets another object; it is about perturbations that produce more change and different configurations. Clam diggers in the Bay use the term *swirl* to describe what happens when waves wash over shellfish beds and catch on intruding shell. Swirl is an intra-action, in Barad's (2007) sense, that creates a whirlpool around the shell that draws clam seed down into the mud. Diggers can accentuate potential intervention of the tides by "brushing," a practice whereby they stick small conifer trees in the mud to create more perturbations in the tides. Working the tides, creating swirls, is not a "static relationality but a doing—the enactment of boundaries—that always entails constitutive exclusions and therefore requisite questions of accountability" (Barad, 2003, p. 803). The agents--the water, waves, mud, rocks, humans, clams, brush and more

> are not ‘things’ but phenomena—dynamic topological reconfigurings/entanglements/relationalities/(re)articulations. And the primary semantic units are not “words” but material-discursive practices through which boundaries are constituted. This dynamism is agency. Agency is not an attribute but the ongoing reconfigurings of the world. (Barad, 2003, p. 818)

Admittedly, swirl is not the same phenomenon as diffraction. However, the mutual emphasis in diffraction and swirl on waves, perturbations, intra-action between materials, and multiple overlapping and dynamic effects is an appropriate analogy. This analogy also allows us to dwell closer to shore as we work the tides.

3.4.2. Symbols and Materials in Working the Tides

While those who conduct conservation action planning in landlocked places may not adopt an orientation to process as working the tides, they will likely have metaphors from dwelling that can help clarify where capacities come from and how these may be strengthened and changed. In a similar way, Druschke (2013) describes how rhetorical approaches to watershed–where she understands watershed as both material and symbol–can help inform conservation efforts. We follow her lead and want to organize *working the tides* as a symbolic and material metaphor. However, the distinction between symbol and material begs the question: how do we differentiate the two? Importantly, we do not refer to symbol as fixed representation but symbol as produced from and with materials in dynamic relationships based on affectivity (Barad, 2007; Whatmore, 2006). This view corresponds with Barad (2007) who draws from Hacking (1983) to note that what constitutes the real–including symbols and materials–is based on the ability to intervene. In this way, symbols and materials become agents who

participate in continual interventions in the world (Barad, 2007). We emphasize *intra-action* as a way to continually articulate bodies, and not just human ones, as dynamic and entangled phenomena.

Symbols–things like words, images, and other objects that label and in doing so negate other possible articulations–always have a base in materiality through the practices that constitute them. In studies of science, Latour (1987) shifts our attention from symbolic representation to symbols as inscriptions and how these become *immutable mobiles*. A primary difference between symbol and material becomes one of mobility and territory (Deleuze & Guattari, 1987; Latour, 1987). Symbols can intervene in ways that materials like watersheds, like tides, cannot and vice versa. In a restricted sense, symbols can move independent of territory. For example, agents working on watershed planning in Iowa in Druschke's (2013) study are not directly affected by the daily rhythms of the tides. However, if they wanted to schedule a planning meeting by the tides they could almost instantaneously consult a tide chart, a material entity characterized by symbolic inscription, but not the *actual* tides.

One might object to this distinction, noting that instantaneously checking the tide charts is only possible through the vast material network of the internet and that the tide charts are dependent on the tides. This point simply reaffirms the material tracing for all symbolic de-territorialization (Deleuze & Guattari, 1987). The movement of symbols through internet territory changes the intervention from previous versions where tide charts were inscribed to paper and not binary code (Latour, 1987). The difference is that the tide chart or watershed map as symbol can interact with agents in Iowa; however if the agents in Iowa want to let the tides diffract between their legs, they must go to the

coast. The tide as symbol can intervene in ways that the tide as material cannot. However, the symbol is always constituted materially through intra-action and always re-territorialized as an "exteriority within" in the Bay, in Iowa, and beyond (Barad, 2007; Deleuze & Guattari, 1987).

We use territory as a boundary, where symbols are materials that intervene in unique ways. We subtly distinguish between the two through the question: where and how does this agent intervene? When we describe observations on group communication and stakeholder engagement based on our use of systems theories, we largely see that as a symbolic level. This is where we focus on interactions through the use of symbols to influence group work and relationships which is guided by systems theories that direct our attention to human interaction through language as a system of symbols. Again we note the material tracing in this focus on symbols, as Thompson's (2009) research was based on an interdisciplinary collaboration in another territory. Her CCC list has moved into our collaboration to shape the focus of our inquiry. Her more than 400 pages of field notes is just one marker of the materiality that supported her symbolic production. Similarly, Senecah's (2004) discussion of Trinity of Voice moves and now intervenes in a variety of contexts (Klassen & Feldpausch-Parker, 2011; Thompson et al., 2010; G. B. Walker et al., 2006). Our discussion of the material dimension of working the tides focuses on how materials themselves intervened in our research process in ways that our systems theories did not address (Barad, 2007; Bennett, 2010; Whatmore, 2006). It is a distinction bound by the practice of our communication research and a messy one, as it should be. The distinction also attempts to continually shift "concern from what things mean to what they do" (Whatmore, 2006, p. 604). To maintain the messiness, we keep

the symbolic and material interwoven in our methods and discussion, with transitions occurring across and within themes in our descriptions of the agents involved and the strains of additional inquiry and insight that came from those (Barad, 2007).

3.4.3. Materiality and Method

We want to briefly frame how our discussion of materiality connects with the methods we describe below. Taking up Whatmore's approach (2006), we "supplement the familiar repertoire of humanist methods that rely on generating talk and text with experimental practices that amplify other sensory, bodily and affective registers and extend the company and modality of what constitutes a research subject" (p. 606-607). Pezzullo's (2003) investigation while part of a Sierra Club Toxic Tour of "Cancer Alley" between Baton Rouge and New Orleans, Louisiana illustrates this amplification. The reader knows from her thick description that she spent three weeks traveling with the tour and interviewing participants. She details the thinking that went into her choice to transcribe interviews and oral performances differently. She notes the use of particular sensory extending technologies and says she acted as

> a participant-observer, an interviewer, an activist, a reader of books, newspapers, and other archival sources. In my critical representations of this toxic tour, therefore, I integrate analysis, theory, videotape transcripts, interview transcripts, a photograph and field note excerpts. (Pezzullo, 2003, p. 229)

There is an unfolding quality to this method as her research responded to new insights and needs for critical inquiry. Using a slightly more mechanical yet no less illustrative style, Kinsella (1999) describes his "Procedures" during the first nine months of his fieldwork in which he "made approximately 60 visits to the laboratory, totaling about 300

hours of research. I maintained office space in the area assigned to the Physics Program Division and received all division-wide written and electronic messages" (Kinsella, 1999, p. 182). These descriptions are themselves part of the material construction of those bodies participating in and at the same time co-producing these places. At the level of materiality, writing the word "office" is not to be taken as producing the thingy-ness of the office. However, this detail helps draw attention to the *thing power* of the office in the development of Kinsella's observations (Bennett, 2010).

In what McGill (2006) calls her "Back Story" she illustrates another way to be specific about the bodily performance of field work, even though her activities did not involve traditional techniques like interviews and or document analysis. Instead, she sought to read the Gerbode Valley as a discourse and let its patterns "speak" to her. Of her method she says

> again and again I returned, walking the same trail over and over…Years of drought and seasons of rain; days of fog, of sun, and of both, the light breaking just before me. Locals, some human and some not, taught me many things. Barn owls, egrets, voles, and newts; deer and bobcats; willow, berry, and sedge much of the time I just sat and watched. Slowly, ever so gently, I became learned in this place. (McGill, 2006, p. 391)

In this brief discussion of methods and materiality, we highlight the bodily production of research; the unfolding quality of insights drawn from diverse sources; and how materials, in our case mud, tides, computer software, food, humans, and more influenced how we worked the tides as research method.

To summarize, systems theories help direct attention to the interactions that occur as individuals work together in different types of organizations; structures and processes that influence these interactions; and multiple emergent outcomes, including sustainability values and boundaries (Norton, 2007; Senecah, 2004; Thompson, 2009). Material perspectives recognize that resources are not symbolically *mobilized* in systems. Instead, materials are fundamentally participatory in relationships that decenter humans as primary actors and agents of change and where assemblages of actors, human and more-than-human, co-produce sustainability (Bennett, 2010; Latour, 2007; Rickert, 2013; Whatmore, 2006). In both, communication depends on resilience as a dynamic affectability (Stormer & McGreavy, Under review). This affectability influences how capacities for learning, identities, networks, institutions, memory organize in ongoing systems of becoming. By bringing resilience, sustainability, systems, and materiality together, we understand capacity within a conservation action planning process from multiple, entangled, and dynamic standpoints.

3.5. Ethnographic Research Design

We used a combination of qualitative methods in an ethnographic research design, including participant observations, formal and informal interviews, focus groups, collaborative capacity building sessions, and document review (Corbin & Strauss, 2008; Hesse-Biber & Leavy, 2008; Patton, 2002). Figure 3.1 is inspired by tidal and moon

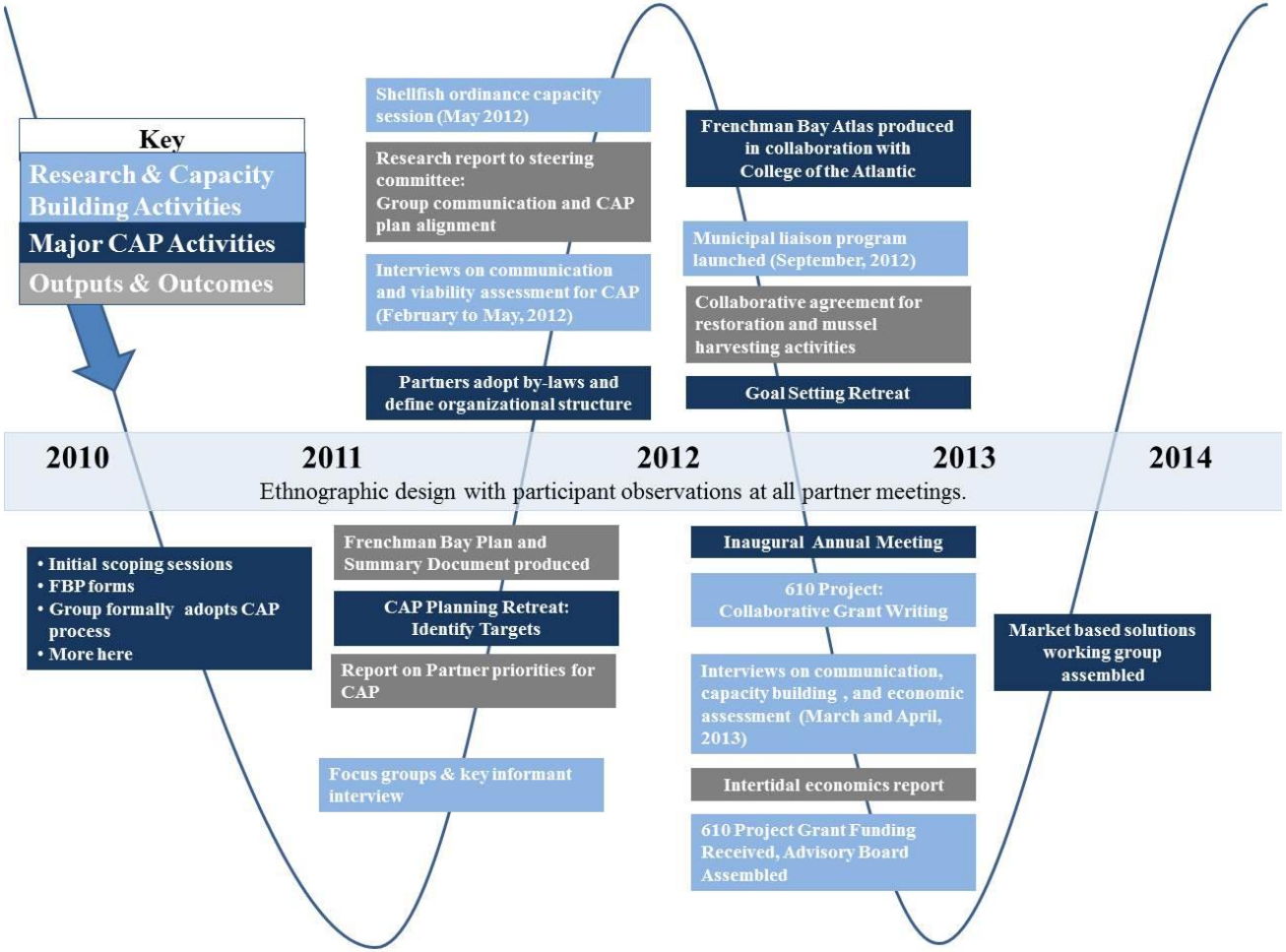

Figure 3.1. Tidal timeline of major activities for the Frenchman Bay Partners.

phases and shows how we proceeded through the conservation planning stages (Margoluis et al., 2009; Salafsky et al., 2002). We situate this work within the material context in which the tides affected and capacitated our various activities in dynamic cycles of research, planning, and strategic interventions.

3.5.1. Geographic Scope

Figure 3.2. Frenchman Bay at Hadley Point looking north.

Frenchman Bay (Figure 3.2) is in the State of Maine on the eastern side of the island formally referred to by the Wabanaki, the original human inhabitants, as Pemetic or sloping land. This sloping land is now more frequently called Mount Desert, named by French explorer Samuel Champlain for the seemingly bare, distinctly pink granite that intruded the Earth's crust approximately 350 million years ago and now forms the island's exposed mountains. One can imagine Champlain, from his boat, pointing "Regard. C'est une île des Monts Déserts." Traversing these same mountains on foot reveals them as anything but bare, with their diverse lichen and rock-crevice communities. What is *desert* depends on stand-point.

The map in Figure 3.3 was produced by the Maine Coast Heritage Trust using Geographic Information Systems (GIS). This map shows the Frenchman Bay watershed as defined by highpoints of land that direct water into one or more of the 13 towns and 3 unorganized territories that fall within this boundary. Three major rivers drain into the Bay, including the Skillings, Jordan, and Taunton Rivers. The mean tidal range in the Bay is approximately 11 feet. As Pyle (2006) describes, "Tides are the ocean's slosh, long-period waves caused by the tug of the moon and the sun, affected by the Earth rotation and the moon's orbit" (p. 360). Though lines on the map tell us when we enter the watershed, we also know we're there when we roll down the window and smell where the tide is at: cool and crisp on the insides of our nostrils when it is in. We taste its heaviness at the opening of the esophagus when it is out.

3.5.2. Research Practices

Our primary method consisted of ethnographic observations at 43 project meetings, including steering committee meetings; conservation planning retreats; key partner events such as the monthly Frenchman Bay Regional Shellfish Committee meetings and selectboard meetings; an annual meeting; and project-related conferences. We audio-recorded major events such as the annual meeting and conservation planning retreats. At more routine and task-oriented meetings, researchers conducted real-time transcription and took detailed field notes. We also observed and archived approximately 260 e-mail discussion threads, most of which consisted of multiple individual e-mails.

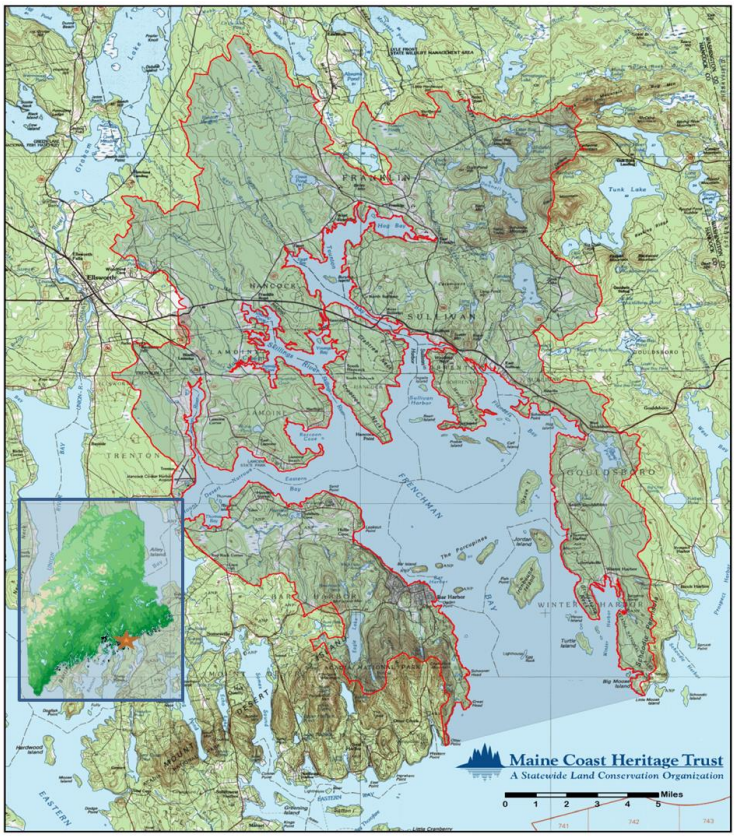

Figure 3.3. Watershed and locus map for Frenchman Bay.

In addition to informal interviews with collaborators that occurred as part of the participant observations throughout the project, we used a combination of purposive and snowball selection techniques to invite participation in focus groups and formal interviews (Patton, 2002). We conducted one interview with a participant who declined to participate in the focus group and elected to be interviewed individually and two focus groups with a total of 15 participants in September, 2011 (Appendix F). These informed the development of a technical report to support the initial conservation planning retreat in October, 2011 (McGreavy et al., 2011). We then interviewed 13 Partners involved with the initial steering committee from February through May 2012 (Appendix G). We asked questions focused on group communication such as: How do you feel about how the group members work together? Do you have access to information about how this

group makes decisions and how this access could be improved? We also asked questions about the emerging conservation action plan, including: when you look at this plan, what do you notice first? What stands out to you and is there anything missing? To assess changes in communication dynamics and to verify our interpretations, we interviewed a subset (n=8) of the initial group of Partners again in March and April 2013 (Appendix H), for a total of 22 formal interviews. Interviews lasted approximately 1 hour and were audio-recorded and fully transcribed.

Through the participant observations, focus groups, and interviews we identified collaborative capacity needs. We subsequently developed and implemented three collaborative capacity building projects. The first featured facilitated discussion and follow up activities to support collaborative ordinance development among members of the shellfish committee, mussel harvesters, and aquaculturalists. These stakeholders were potentially affected by the shellfish committee ordinance to regulate mussel harvesting in the Bay. We also hosted a collaborative capacity building session among eel grass restoration scientists, mussel harvesters, and aquaculturalists. Finally, we collaboratively wrote and received a grant from the Maine Community Foundation to build capacity towards opening the 610 acres of restricted clam flats in Frenchman Bay.

Our data collection resulted in more than 1,000 pages of field notes, interview transcripts, and related documents. We analyzed project texts using themes developed from resilience thinking, systems theories of communication, materiality, and from our engagement in the Bay. We member checked our interpretations by consistently having two or more observers at most meetings and continually discussing our observations through debriefing, comparisons of recorded field notes, collaborative presentations, and

writing projects (Corbin & Strauss, 2008). Member checking was led by the first author and included every other author on this paper in combinations that varied depending on the phase of the project.

3.6. Working the Tides

We use the metaphor of *working the tides* to discuss our results. In this section, we describe key insights from our study and organize our main points through themes related to working the tides. Our primary findings are that 1) rough seas are necessary and inevitable; 2) checking the tide charts improves access to participate and abilities to work with difference; 3) creating strategic swirls improves capacity; 4) boundary objects can help navigate and chart a course and 5) conservation action planning and sustainability depend on our ability to keep coming back. In each section we draw quotes from interviews, focus groups, and participant observations that illustrate how, by working the tides, we strengthened collective capacities for actions in the Bay. As noted above, our distinction between the symbolic and material is always rooted in the material and in the mode of intervention and we hold these together in dynamic and mutually influencing tension (Barad, 2007). Our discussion of group communication and stakeholder engagement draws from systems theories, which are largely focused on symbolic and interpersonal interactions. Our discussion of the material participation of food, mud, and tides examines how these materials intervened in our research and influenced collective capacities.

3.6.1. Rough Seas Are Inevitable and Necessary

The concept that rough seas are inevitable and necessary refers to how difference in the Bay was productive (Daniels & Walker, 2001; Deetz & Simpson, 2004). We saw

difference and conflict in all parts of the conservation action planning and partnership development process. In the earliest focus groups that informed the beginning stages of the conservation action plan, clam diggers described conflict with worm diggers and mussel harvesters. We observed tension in steering committee meetings where Partners disagreed about bylaws, the vision statement, and the habitat and species targets that should be included in the plan. In efforts to reach out to municipal officials, there were marked differences in how receptive towns were to the Partners. In some cases, towns enthusiastically supported joining the Partners network. In other cases, we could not even get on the selectboard agenda. Rough seas, as a metaphor for difference and emergent conflict, were a primary and necessary condition throughout.

In this section, we set up a conversation drawn from our transcripts and notes among Partners who describe differences and resulting conflict and who also identify the need for communication to work through (Daniels & Walker, 2001). We do this to demonstrate that the conservation planning process within Frenchman Bay is not based on easy friendships among people who always agree with each other. Indeed, as one of the leaders of the planning process said after describing long-term working relationships with many of the group members: "One thing that's interesting is that for all these people that I work with and have worked with, none of us get together socially. So, these people aren't my friends. Just so you know." Difference, and not necessarily friendship, is an underlying condition for how the Partners work the tides. This does mean to say that the Partners were always at odds or that they did not like each other or have existing social capacities, like trust based on longstanding relationships, that promoted their ability to get things done (Leahy & Anderson, 2010). They demonstrated several social capacity-

related patterns. Difference as the underlying condition is about the diversity of interactions that were always present and the many types of boundaries Partners crossed as they worked together. Here we describe some of the key differences we observed and how Partners described the role for communication. In the following sections, we expand on the specific material and symbolic communication practices that the Partners used to wade through rough seas towards creative advance.

Referring to some of the differences in the Bay, Gerald, a selectboard member and municipal Partner, said

> *We have science. We have politics. We have passion. We have people trying to make a living. The one thing that's going to tie all this together is a little bit of common sense. And we need to make sure that's on the table at all times. And I love the Bay. I moved from potato country to the Bay. I fish it. I clam it some. I kayak on it. I bring my friends and relatives and my grandkids to it. And it's important. But it's also the basis of our economy.*

Gerald made this statement at the collaborative capacity session among clam diggers and mussel harvesters where Partners created a space to talk about the development of an ordinance that would regulate mussel harvesting. This quote highlights several dynamics that influence differences. Gerald describes at least two forms of knowledge, namely knowledge derived from science and from personal experience. He notes how politics and power can shape the ways in which people think and act in the Bay. He talks about his own experience, his recreational and livelihood activities, his family connection, and how these experiences promote a sense of place, feelings of love and emotional attachment, and an interest in protecting the Bay for present and future generations. He also makes the point that livelihoods and the economy of the Bay flow in and out with the tides. The differences Gerald describes, and many more beyond, continually shape interactions in and with the Bay. This notion of "differentiating is not about othering or

separating but on the contrary about making connections and commitments…The intra-actively emergent 'parts' of phenomena are co-constituted" (Barad, 2007, p. 391-392). As we demonstrate in the quotes below, our sources of knowledge, divergent life experiences, the ways we work the tides for an income, and our feelings of attachment to the Bay are some of the parts that allow us to identify what to prioritize as sustainability values that shape how we work together to make those priorities happen.

The Frenchman Bay Regional Shellfish Committee (hereafter shellfish committee) is a key Partner group that became involved with the conservation action planning process in the earliest stages. As one member described, "Our group is made to ensure economic opportunity for 82 commercial clammers, plus 200 seasonal recreational harvesters too. We do some conservation work. We are trying to support those making an income on the tide." This group self-organized to collectively manage the intertidal mudflats in the seven towns in Frenchman Bay who are members of the shellfish ordinance. This is the largest regional municipal shellfish program in Maine. As seen in many case studies, the collaborative management of a common pool resource in which there are multiple user communities comes with a host of challenges (Berkes & Folke, 2000; Ostrom, 1990). The differences and conflict among clam diggers, worm diggers, and mussel harvesters is evident in this exchange between two clam diggers:

> *Frank: On the whole the clam diggers and the worm diggers usually get along pretty well.*
>
> *Tony: Yep, they're there and we're here. You know its two different lives.*
>
> *Frank: Most generations you get into an area where the worm diggers are digging, they don't normally get down where they're going to break a lot of clams. They'll break some, but they're not going to ruin the whole thing.*
>
> *Tony: For the most part, they just get squirted all day.*

(laugh)

Frank: So it's not, usually not that bad.

Tony: Not like the draggers.

In this context, Frank and Tony compare the respective impact of worm digging and mussel dragging on their ability to make an income on the tide. Their characterization of worm digging as having a limited impact on clam digging is inconsistent with other characterizations we heard. In other interviews and observation contexts, clam diggers strongly emphasized the conflict with worm diggers. In these characterizations, clam diggers described how worm diggers overturn mud and can displace clam seed in areas where clam diggers are trying to regrow clams. However, here Frank and Tony note that mussel draggers have a greater impact.

In another interview, a mussel harvester responds to the claim that his industry is destroying the mudflat when he says

> *Roger: One problem is communication. I've never been informed of where clammers are seeding. If it's available on a website, then we're not going to drag there. I'm president of [a major shellfish organization] and if there are problems, I'd address it.*

Unlike the worm and clam diggers, mussel harvesters work the tides when they are in. Unless they are harvesting mussels by hand which most do not, they do not inhabit shared space on the mudflats. They do not, like the worm diggers, get squirted by clams all day. The boundaries among clam diggers and mussel harvesters and emerge, at least in part, from how the tides bring them into the Bay at different times and the mechanical technologies they respectively use to harvest shellfish.

Several Partners spoke about the need to promote communication to find ways to work through these and many other differences in the Bay. Elaine, a mussel aquaculturalist, echoes Roger's call for communication when she says

> *You don't necessarily have to be exactly on the same page every step of the way…It's much easier to have that communication that's in an early stage then be approached with something that has spent a lot of time developing then turns out to be very difficult. The only way you can do that is to hit it hard from legislation or something.*
>
> *Communication is always the key. Working on the water is even more so than perhaps in any other experience I've had, actually. You really need to because it's a kind of a wild west out here.*

We put the quotations from Frank and Tony in conversation with Gerald's discussion of common sense and Elaine's and Roger's perspective that communication is important. We want to introduce a way of thinking about communication from systems and material perspectives and interpret *common sense* in a way that will open an understanding of how rough seas are necessary for sustainability.

Common sense, and the related term common ground, is often interpreted as a perspective shared by all. However, the interpretation of *common* raises concerns about power (Deetz & Simpson, 2004; Giddens, 1984; Mumby, 2000). Who decides what is shared? Whose voice is left out and what are the implications of that exclusion? In his discussion of the problems with the concept of common ground, Mumby (2000) notes:

> In some ways, too much consensus and common ground can be dangerous because it erodes the possibility for critique and transformation, and heightens the possibilities for the hegemony of a single discourse. Ultimately, the trick is to maintain a constructive tension between consensus and common ground on the one hand, and dissensus and difference on the other. (p. 86)

Mumby (2000) calls for a productive tension between the need for shared understanding and the need to maintain difference.

In situations characterized by diversity and plurality, consensus may simply not be possible nor desirable if the goal is to create flexible institutions that can accommodate multiple viewpoints (Daniels & Walker, 2001). More importantly, as Daniels and Walker (2001) have observed, consensus "is not a prerequisite for making progress on vexing natural resource management" (p. 73). Instead of consensus, thorough conflict assessment may enable collaborators to find ways to work through. Conflict assessment may also promote the ability to "trace connections between the controversies themselves rather than try to decide how to settle any given controversy. The search for order, rigor, and pattern is by no means abandoned" and instead "actors are allowed to unfold their own differing cosmos, no matter how counter-intuitive they appear" (Latour, 2007, p. 23). This approach to difference may promote new modes of being in the world and with each other.

Successful collaboration requires that we productively engage the tension among commonality and difference (Daniels & Walker, 2001; Deetz, 2008; Deetz & Simpson, 2004). Returning to Gerald's call for common sense above, we interpret this statement as a genuine search for a way to bring these differences together. But we also see within his call economic interests as positioned as the basis for determining what makes sense in the Bay, an interpretation that is consistent with other interpretations of sustainable development discourse (Peterson, 1997). Brett, a core Partner on the steering committee, agrees that economic interests dominate but he also demonstrates how other terms, in his

case sustainability and conservation, can similarly attempt to wipe away difference in the drive towards shared vision:

> *Bridie: What I am hearing you say is that you would like to have more open dialogue about conservation as part of the vision, within the group.*
>
> *Brett: Well, it [referring to the term conservation] is not part of the vision. But 'sustainable' is not a four letter word. That's in there because I kept saying that. Let's just talk about sustainability and as we talk about it, the word conservation will come up. We should keep reminding ourselves of what our vision is and I think it should just follow, that things will start being more pleasant for me.*

Our point in contrasting Gerald's emphasis on economics with Brett's on conservation is not to say that one overarching discourse dominated the Partners' work. There were many differences in perspective about what was and what should be a primary sustainability focus. Some Partners felt that economic interests dominated the planning process. Other Partners felt that economic interests were not well represented and that conservation, education, or research interests were of primary concern.

Instead, we pair Gerald's call for common sense with Tony's discussion of shared experience on the mudflat. We introduce a way of thinking about commonality that potentially avoids the kind of closure that can occur when common sense or common ground is approached as a space of agreement or consensus. Tony says the worm and clam diggers can find ways to get along because the worm diggers "get squirted all day" by the clams. In this way, the clams create a shared material experience. This shared experience is produced in the act of being together on the mudflat at the same time–when the tide is out and the mud is exposed. The tides, clams, and mud intervene to promote identification, what Burke (1969b) refers to as consubstantiality and Davis (2010) calls response-ability, among the clam and the worm diggers.

From this perspective, common ground and common sense is not a shared understanding. Common sense is shared intra-actions: on the mudflat, in conference rooms, in e-mail correspondence, and more (Barad, 2007). Common sense is not bodily perception but a condition of mutual vulnerability, the awareness that we are affected by the world and each other (Stormer & McGreavy, Under review; Whatmore, 2006). The one thing that does tie all this together, that allows us to communicate, is common sense as a *shared condition of response-ability* from which we derive our capacities and through which we may co-construct sustainability ethics (Barad, 2007; Davis, 2010; Rickert, 2013).

When we say that roughs seas are inevitable and necessary, we call attention to how the world is composed of difference which continually creates more difference (Grosz, 2011). From this view, complexity arises as series of contrasts (Whitehead, 1978): in how we live our lives, what we know, what is important to us, who participates and collaborates in planning, and how we affect each other and create more change. The roughness of the seas is about perturbations that occur as different sorts of materials co-mingle in spaces of mutual vulnerability, including humans trying to do conservation action planning to create sustainability in and with the Bay.

What do we do when rough seas are essential for our capacities? Sheldon, a shellfish dealer, emphasized early on that

> no one thing is most important. It is a host of things together that add up to the health of Frenchman Bay. It's the ability to produce harvestable products for the economic side of it and to maintain a balance for the ecosystem around it.

How do we approach each other and the world as if no one thing is most important and still maintain the diverse perspectives essential for learning, creativity, and innovation? As the following points demonstrate, checking the tide charts, strategically creating spaces for interaction, engaging in boundary work, and making the commitment to keep coming back can help promote the ability to collectively determine what adds up to health. From these entanglements, we figure out how to work with difference to promote dynamic "balance" through continual change (Barad, 2007; Grosz, 2011).

3.6.2. Check the Tide Charts

When we accept that rough seas are inevitable and productive and that common sense is about shared vulnerabilities and not shared perspectives, attending to the ways in which we promote potential from *common sense* in the planning process becomes paramount. To this end, one of the most important commitments that the Partners made in their conservation action planning was to regularly check the tide charts. Checking the tide charts refers to the ways in which the Partners structured their group communication and stakeholder engagement and how they changed their collaboration based on emerging insights. Broadly speaking, checking the tide charts was the commitment to understand, as much as possible, the complexity within the Bay by identifying, describing, and including unique and divergent perspectives in the planning process (Daniels & Walker, 2001). On a more material level, checking the tide charts literally meant pulling out a tide chart to consult the position of the moon and the corresponding height of the tide before scheduling meetings with Partners who work the tides in different ways.

Checking the tide charts became an important strategy to promote the inclusion of diverse voices in the planning process and collaborative capacity sessions (Senecah, 2004). This strategy occurred in the earliest stages of the collaboration, before the collaborators decided to pursue the conservation action planning process. The goal of these early meetings was to assess the interest in doing some kind of planning in the Bay to promote sustainability. A core group of people emerged out of these early meetings and officially adopted the conservation planning process. Rachel, a leader in the effort, describes how the group made an early decision to pursue the planning. Talking about a day-long stakeholder meeting in which she invited speakers to talk about different types of options for Bay planning she says

> *Rachel: 'Anyhow by the end of the day, people still weren't sure that there was one type of plan in particular because Caroline gave a talk and she wasn't really bought into conservation action planning. So, her talk really got people thinking about 'Maybe we don't want to do that because it's so constructed that we won't be able to tailor it to meet our local needs'....But, where we got to by the end of the whole meeting, Michelle facilitated, as she has for many meetings. And she actually had us vote yes or no, up or down: 'Are we planning or are we not?' She had us put out heads on the table with eyes closed so one would see how each other voted. And unanimously, the room which had a makeup somewhat like the first stakeholder meeting. Not all the same people in the room and some new people in the room. But people voted: let's do planning.*

From the earliest stages, collaborators created a shared decision making space. Stakeholders had access to participate in choosing the planning approach. As the attention to the voting process shows, the early decision making was structured so that people could safely express their support without feeling pressure from the group, which likely enhanced their feeling of security to participate (Norton, 2007; Senecah, 2004). The commitment to provide continual access to information and influence in the decision making process carried throughout all stages of the conservation action planning process,

including the focus groups which sought to understand and include a diversity of perspectives and follow up interviews that aimed to align the emerging plan with previously stated and possibly changing priorities. There was strong agreement in all of the interviews throughout the project that collaborators felt that they had access to the information and decision space they needed to be able to effectively participate (Norton, 2007; Senecah, 2004). Further, interviews and participant observations consistently revealed a high degree of collective communication competence (Thompson, 2009). William demonstrates this in his response to a question that asked about communication dynamics and whether he feels comfortable expressing his voice:

> *William: Yeah, I think [my voice] is heard. Especially when in the group setting, I think the comments that are heard, I feel like people have made relevant comments to it. You get feedback in the discussion and people aren't just sort of like not…In some of the smaller sub-groups or through some of the direct communications you see direct results from communications. Again, when Charles, Peter, and I did the fine-tuning the bylaws before bringing it back…comments that I made were incorporated into that process.*

Active listening, as an embodied practice of responding to comments and incorporating diverse perspectives, is an important feature of CCC (Thompson, 2009). These and other features were consistently described and observed throughout the planning process.

What effect did inclusive decision space and these modes of interaction have on efficiency, relationships, and outcomes in planning? Interestingly, Caroline, the speaker to which Rachel referred above, described a marked change in her opinion about the utility and flexibility of the conservation action planning process. In the first interview, Caroline expressed doubts about using Miradi to guide the conservation action plan because it followed what she saw as an overly formulaic set of steps. In the second

interview a year later, she described this process as a model that she had adopted in her own work based on the successes she observed in the Partners' collaboration:

> *Caroline: And [this other planning process] they want us to illustrate existing models that the people in [another Bay] could try to emulate. So, I actually have to write up something about Frenchman Bay Partners, which will not be hard to do. So, you are doing so well that you are a model. You are the benchmark for other people to aspire to.*

This point is especially noteworthy given that Caroline initially expressed concerns that the process was too rigid to be adapted to local community needs. The Partners' commitment to check the tide charts early and often encouraged the kind of buy-in to the process and created the conditions for stakeholders to have access to the planning so it would be flexible and adaptive.

In addition to setting up inclusive decision making and engaging in scoping to understand and promote the incorporation of diverse perspectives, project leaders increasingly recognized the importance of literally checking the tide charts as a practice to enable participation. John, a clam digger, demonstrates the need to check the tide chart in an e-mail he sent to Partners who were trying to schedule a meeting related to efforts to open closed clam flats in the Bay. He said:

> *Hey All,*
>
> *I see Wednesday the time is right on low water. I know that won't work for most of us that clam. I see too, that some of the morning tides I indicated I can make, I cannot. I'll change that later [on the Doodle].*
>
> *Here's the tide chart: http://me.usharbors.com/monthly-tides/Maine-Downeast/Blue%20Hill%20Harbor/2013-05*
>
> *Thanks!*
>
> *John*

Meetings scheduled at high tide enabled the participation of those whose work on the tides brings them out onto the mudflats to harvest clams, worms, or seaweed. Conversely, meetings scheduled at low tide favored the participation of those who work the tides on boats, like mussel harvesters and growers. In situations with dynamic tidal cycles where Partners work the tides in different ways, there will never be a single best time to hold a meeting. Instead, promoting voice relies on attending to this point of complexity, recognizing what some people may have to give up in order to participate, and trying to find ways to distribute those costs equitably over time and by drawing on different types of incentives.

As noted above, we identified escalating conflict among clam diggers, mussel draggers, and mussel growers during our stakeholder interviews, focus groups, and participant observations. Members of the shellfish committee and other Partners requested that we create a space for dialogue in the development of an amendment to their shellfish ordinance that would regulate mussel harvesting. We recognized the challenge of trying to find a time that would work for all, given that clam diggers and mussel harvesters and growers work the tides at different times. The following exchange that occurred at this collaborative capacity session demonstrates this challenge:

> *Derrick: There needs to be an annual meeting. You've got to figure out when that works where mussel harvesters bring data, clammers bring data, and everybody compares data to figure out what's really going on.*
>
> *Elaine: And can't be low water, can't be high water. What are we going to do? (Group laughter)*
>
> *John: Well, I miss a lot of tides.*
>
> *Elaine: So do we.*
>
> *John: So we got to miss them together.*

In cases where groups worked the tides differently, as was the case with clam harvesters who work the tides when they are out and mussel harvesters and growers who work the tides when they are in, Partners recognized the difficulty in getting these groups to the same table at the same time and they tried to be as inclusive in their meeting times as possible (Senecah, 2004).

Conservation action planning in a marine watershed that also intends to be collaborative and involve stakeholders must take the tides into account. The tides help determine who has access to participate at any given time. From both systems and materiality perspectives, who has access to participate fundamentally changes what emerges from collaboration as intra-actions (Barad, 2007; Senecah, 2004). The Partners' commitment to check the tide charts as a meeting practice enabled the participation of stakeholders who helped identify intertidal mudflats as a key habitat focus in the conservation action plan, along with eel grass, migratory fishes, and ocean bottom habitat. Checking the tide charts more broadly helped the group recognize that there were multiple perspectives that needed to be incorporated in the planning. It also helped group members appreciate difference and understand conflict. This scoping promoted the emergence of strategies to work through conflict and grow collaborative capacity in the Bay, as we now describe.

3.6.3. Strategically Create Swirls

Above we demonstrate how rough seas are inevitable and how checking the tide charts can inform choices about how to promote voice. Inevitably, checking the tide charts also results in the identification of emergent needs to stay at the creative edge before conflict turns destructive (Deetz, 2008). In this section, we take up the clam

digger practice of strategically creating swirls, inspired by how Frank and Tony describe it here:

> *Frank: A lot of the seeding in at some places–he's talking about clams coming in where there's just bare mud. If you got the right swirl in your current that'll help it too. I think that's up there in the head of Skilling's River. You look at the lay of the land, how that tide comes in there, I think you're getting a pretty good swirl action. And I think that's a lot of what happens in Raccoon Cove too. You get a certain action it'll bring the seed down.*
>
> *Tony: If it just goes in and out like that, like on this floor, that seed ain't got nowhere to grab nothing.*

At a material level, the way in which we strategically create swirls looks quite different in our respective efforts to grow capacity. The clam diggers use conifers out on the mudflats and we use maps in meeting rooms and grant proposals in pizza shops. But as phenomena, in Barad's (2007) sense of the term, looking at the lay of the land for intervention suitability and understanding the complex dynamics of the tides to enable change in specific directions is strikingly similar.

The Partners continually found ways to strategically intervene by creating swirls. This type of intervention provides a fundamentally different orientation than the top-down command and control model that has often been used in natural resource management and environmental policy settings (Cox, 2010; Depoe, Delicath, & Elsenbeer, 2004). This is a type of intervention that follows a non-linear complex systems view where "random disturbances can produce unpredictable events and relationships that reverberate throughout a system, creating novel patterns of change" (Morgan, 1997, p. 262). In these interventions, we do not possess control over the outcomes but we can observe some of the effects and make continual attempted adjustments based on the patterns that emerge. These interventions accept that

> future moments don't follow present ones like beads on a string. Effect does not follow cause hand over fist…Our (intra)actions matter--each one reconfigures the world in its becoming--and yet they never leave us; they are sedimented into our becoming, they become us. (Barad, 2007, p. 394).

These strategic interventions then are based in a trust in our own becoming. This trust is etho-ecological, "a way of shaping that is always individual, limited, obstinate, and a wager on an environment that confirms and nourishes it" within multiple bodily entanglements (Stengers, 2011, p. 164). This is an arrangement in which the world pushes back and into itself as it enfolds. This dynamic is one of the reasons why, as we describe below, the commitment to keep coming back is integral to creating swirls. Sustainability is a commitment to becoming.

As Frank and Tony describe it, the commitment to creating swirls starts with getting a feel for existing patterns in the terrain, for checking the tide charts in multiple ways. From this perspective, those who work the tides can determine the types of materials and the locations that would most likely produce the intended effect. Importantly, these decisions are never perfect and the possibility for unintended consequences is always present (Barad, 2007; Morgan, 1997). By checking the tide charts, the Partners identified the need for and organized three collaborative capacity building efforts. These included the shellfish stewardship session among mussel harvesters, aquaculturalists, and clam diggers; the eel grass restoration and harvester appreciation event among mussel harvesters and eel grass ecologists; and the 610 Project which was a collaborative grant to restore and open closed clam flats. For each of these efforts, checking the tide charts began with ongoing observations, focus groups, and

formal and informal interviews. Through these investigations, we came to understand some of the surface dimensions and how these could be altered so that the intra-actions would be productive (Barad, 2007). Here we focus on the effects of the shellfish stewardship session and in the following sections we briefly highlight the eel grass and mussel harvester event and the 610 Project.

There were two material-symbolic dynamics that appeared to influence the escalating conflict among the clam diggers, mussel harvesters, and aquaculturalists in the development of the ordinance. First, the mussel harvesters and aquaculturalists did not feel that they had access to the information they needed about how the ordinance would regulate their activities (Senecah, 2004). Second, the groups did not have an inclusive space for working through (Daniels & Walker, 2001; Senecah, 2004). These dynamics are shown in Roger's comment above when he says that he does not have access to the information about where the clam diggers are seeding and here when Elaine, reflecting on her attendance at the monthly meetings, says

> *Elaine: We've been here [to the monthly meetings] many times but I still don't see a plan. My biggest problem is the process. When we discussed it, it seems like we could work as mussel seed harvesters. For seed, we can work with what we thought was a consensus but you haven't put it into the plan and these aren't the same and it takes time to build this up. We've been working with you but the process is arduous and I think it needs to be on respectful terms the whole way through. But I'm optimistic we can work things out.*

The terrain was relatively flat because the only space available for intra-action occurred once a month at the regular meeting of the shellfish committee. The design of the room featured members of the shellfish committee arranged at the front with audience members, including mussel harvesters and aquaculturalists, arranged in facing rows. This arrangement does not create the space for the kind of mutual and open dialogue that

enables the emergence of productive insights and learning (Depoe et al., 2004; Senecah, 2004; G. B. Walker et al., 2006).

In response, the Partners convened a meeting space where participants could literally come to the same table and face each other in dialogue. The starting time was not ideal for the clam diggers, as the meeting began near "low low" tide for the day. However, the meeting lasted 3 hours which produced a balancing effect. As Elaine and John describe above, both groups had to miss their tide to participate. This also meant that those who could not afford to do so were not there, which has implications for power and for who continued to be involved after this meeting. We note this constraint and we do not attempt to resolve. Instead we recognize that

> Intra-actions always entail particular exclusions, and exclusions foreclose the possibility of determinism, providing the condition of an open future. But neither is anything and everything possible at any given moment. Indeed, intra-actions iteratively reconfigure what is possible and what is impossible–possibilities do not sit still. (Barad, 2007, p. 177)

The exclusion of those who did not participate in this particular meeting constrains what becomes at this particular moment. However, these constraints are not deterministic for future intra-actions. We can find ways to change together if we are sensitive to these dynamics.

Given that interventions are dynamic phenomena, how do we observe and make sense of the emergent patterns? For each of the interventions, we continued to check the tide charts and we looked across multiple sites for observed changes. In terms of the ordinance development, we noticed marked changes in the way in which members of

each group described and interacted with each other. Jessica, one of the Partners, who is not a member of any of these groups reflected on this shift here:

> *Jessica: I think it's very fortunate that Elaine and Tim are interested in cooperating to find sustainable ways to harvest. I had heard varying things about them...All my background was gossip and what I had heard about them was negative. So I was quite skeptical.*
>
> *In the subsequent times of meeting with them, that has turned around. I think that they are concerned with finding sustainable ways. I was interested to hear at the last meeting that I went to, which I guess was February [2013], where Frank was saying the wild harvesters of mussels have to take a lesson from how Tim and Elaine do it because they have found a way to drag that doesn't destroy the clams and everything else. So that was quite an admission for a clammer to say because they've been so angry with the mussel dragging.*

Importantly, Jessica was not involved in the active research yet she offered this observation based on her own experience following the session. Her observation helped confirmed ours. Following this session, Frank drove to Roger's facility to learn more about his operations and the innovative harvesting technologies he has created. Tim took Frank out on his boat to show him how they harvest mussel seed. Further, the Department of Marine Resources staff who also participated in the meeting convened a low tide trip so that participants could observe the effects of some dragging practices on the intertidal mudflat. Without the strategic intervention, these subsequent activities and changes likely would not have emerged.

3.6.4. Boundary Work May Help Chart a Course

A complementary yet distinct way of thinking about creating swirls draws from discussions of boundary work we introduced above. Here we put boundary work literature in conversation with observations in Frenchman Bay. The Partners actively worked with multiple boundary objects in their knowledge co-production processes. We again emphasize that boundary objects are not stable, fixed entities but flexible and

dynamic processes through which agents compose relationships and produce knowledge, social order, and material assemblages (Jasanoff, 2004; Star & Griesemer, 1989; Wilson & Herndl, 2007). Boundary objects as "apparatuses are not bounded objects or structures; they are open-ended practices. The reconfiguration of the world continues without end. Matter's dynamism is inexhaustible, exuberant, and prolific" (Barad, 2007, p. 170). We observed dynamic material reconfigurations throughout the Partners' process, including the ways in which food participated in project meetings; the development of the logo in the shape of the watershed; eel grass and the grids on which they were tied for restoration (Kidder et al., in press); maps used in various stages throughout the process. Discussion of each of these could comprise a chapter on its own. Instead, we highlight two boundary objects that were particularly productive: the Frenchman Bay Atlas and the computer software technologies Miradi and Geographic Information Systems (GIS). The atlas and computer models guided practices, promoted learning, and created social and material patterns that continually shaped emerging intra-actions (Barad, 2007; Jasanoff, 2004).

The Frenchman Bay Atlas (hereafter atlas) was an important early boundary object that was initiated after the Partners first planning retreat in October, 2011 and completed in August, 2012. This effort was led by Partners associated with the College of the Atlantic in collaboration with Eastern Maine Community College and the Mount Desert Island Biological Lab (Brett, Petersen, & Longsworth, 2012). The atlas featured a print version with four main sections: 1) basemaps showing elements like town boundaries and watershed features; 2) ecology with information related to important habitat areas and marine resources; 3) culture showing features such as housing densities,

population changes, and coastal development trends; and 4) synthesis that brought the ecological and the cultural together to demonstrate intersecting issues such as point sources of pollution, shellfish closures, and the effects of dams on changes in fish migration patterns (Brett et al., 2012). The atlas also had an online component with interactive maps and datasets. Charles, one of the leaders of the atlas project, demonstrates his boundary-work thinking when he describes the strategic decision making that informed its development:

> *Charles: I want Jim to do a map of overboard discharges before 1970 because I know post-Clean Water Act most of them are going to disappear. I don't think people think about that a whole lot when they think of [making maps]. So, I'm going to be an advocate for Clean Water Act. But I'm not. I'm just making maps. But, that's what I'm doing there.*
>
> *It's not just mapping resources…Some of it's just going be flat-out: here's this, here's that…But some of the maps, some of the more synthetic maps, we're really going to be thinking about what kind of stories we want to try and tell.*

Charles' characterization of the atlas shows how this project was more than a compilation of information. Instead, the atlas was composed in a way that highlighted "*matters of concern*, not only *matters of fact*" (Latour, 2010, p. 478). The atlas produced a space in which clean water was part of the composition to create a "liveable, breatheable 'home'" (Latour, 2010, p. 488) based in an ethic attuned to place.

In addition to the atlas as boundary object, the Partners' use of computer models was an important part of co-production. These objects created spaces for the formation of new understanding, identities, and actions as demonstrated when Rachel says

> Rachel: *So, I guess we all joined the Partnership on the same day [January 26th, 2011]. Because it was a concept that came up after everyone agreeing we wanted to do conservation action planning, and we knew that that bound us together as a group.*

In this way, the use of Miradi as a defining feature of the conservation planning created the conditions for group formation and subsequent changes in identity. The Partners used two different computer softwares that defined spaces of intra-action among agents that were structured yet also flexible and dynamic. Miradi and the real-time GIS mapping that occurred at both collaborative capacity building sessions demonstrated how these softwares created situations in which collaborators could identify what they cared about and also explore how their priorities did or did not match those of others in the group. In working across difference in this way, collaborators produce an "understanding of different views of the same objects and relationships. These juxtapositions provide a rhetorical space to discuss shared and divergent meaning, and to move forward on shared action" (Wilson & Herndl, 2007, p. 151). As has been demonstrated in the limited amount of research available on the use of Miradi, the technical aspects of this software can be cumbersome, constraining, and problematic especially constructs like "targets" and "threats" (Schwartz et al., 2012). Further, this software reproduces troubling dialectics that continually attempt to separate humans from nature (Milstein, 2009). This is a problem associated with resilience discourse more broadly and one that is addressed in the following chapter. However, Miradi also opens up rhetorical space for negotiating these dialectics and continually reconfiguring identities and relationships based on a more vibrant assemblage (Bennett, 2010).

The real time GIS mapping in both of the collaborative capacity sessions operated in much the same way. In advance of both meetings, organizers checked the tide charts with intended participants to try to understand how these objects would be used and to make decisions about ways that the object as process could be enhanced. Leading up to

the meeting, informal interviews identified the need to produce maps that would include both nautical and bathymetric information. The nautical charts were important for the mussel harvesters, as this is the system they use to navigate. The bathymetric information was important for the clam diggers because they identify areas by intertidal surface features. The dual information systems on the maps enabled the groups to describe the world from their own perspective, on the mud or on the water, and at the same time see the world from the others' perspective. Understanding these surface features proved to be essential for productive intra-actions.

To sum up, creating swirls and working with boundary objects is about trying to harness the generative potential in perturbations and intra-actions across difference. These strategies are not about controlling outcomes but understanding the dynamics of the terrain, making choices about how to intervene, and attending to multiple and complex patterns that emerge. The commitment to continue to attend to patterns of becoming is a key theme in our final section as we keep coming back.

3.6.5. Keep Coming Back

Working the tides is a commitment to keep coming back because there are no beginnings and no endings. We are always already in the middle as the tides roll on, a *milieu* "composed not of units but of dimensions, or rather directions in motion" (Deleuze & Guattari, 1987, p. 21). This commitment to keep coming back was based, at least in part, on dimensions that the Partners described as *leadership*. Karen describes her view of leadership in the planning process when she says

> *Karen: Success actually depends on leadership. And we all know what that means. I mean you'd include things like the time, knowing who to network with, knowing how to network with people. These are all really key. And then in the end, you say, 'Well this level of leadership requires funding.' I don't like it when*

> *people just say 'It needs funding.' Well, okay, no. You need to be more specific. What's the real need? The real need is leadership.*

Karen makes the important distinction that leadership is more than adequate funding and time. We understand leadership as something that emerges from intra-actions and this emergence is influenced by things like funding and time but is also conditioned by other symbolic and material entanglements (Barad, 2007). If leadership is entanglement as directions in motion, what does it mean to lead? In the Partners' work, we found that leadership was associated with diversity, decentralization, and humility as a condition of affectability as we now show.

While the Partners adopted an inclusive and participatory process, the initiation of the project was clearly influenced by a small group of people all of whom enacted different leadership-related identities. Rachel was consistently described in all of the interviews and was observed throughout as a key leader. She describes her identity as a leader and her interest in creating a group with diverse leadership styles here:

> *Rachel: So, I happen to know that I'm a visionary leader (laughs) because I went to workshop and I took a test. But one thing that I learned in the workshop was that there are four types of leaders…One, there are visionary leaders. There are structural leaders, people who can put all the pieces in place that need to happen for something to move forward. There are political leaders, who know how to talk to the right people and make things happen. And I feel like the other one was like a human-resources type of leader who knows how to be nice to people and take care of all the people's needs in a project.*
>
> *And, um, and you know I was a little disappointed to find out I was the visionary leader. Because I sometimes see myself in different roles but I clearly fell in that category. And what we learned was that nothing can move forward unless you have all of those leadership capabilities in your group.*

In the interviews, group members also consistently described Rachel as a visionary leader. These leaders promote self-organizing processes because they are particularly attuned "to the area's cultural and ecological values among people of various local

steward associations and local government" (Folke, Hahn, Olsson, & Norberg, 2005, p. 457). Visionary leaders like Rachel can help 1) prepare the system for change; 2) open new opportunities for collaboration and co-production; and 3) foster trajectories for enhanced responsiveness and alternate governance models (Folke et al., 2005; Gunderson, Peterson, & Holling, 2008). In the language of creating swirls, these are people who have a sense of the terrain and can recognize and promote productive interventions (Barad, 2007).

However, as Morgan (1997) notes, vision in leadership needs to be paired with flexibility and diversity. Decentralized models of leadership can enable other leaders in the group to more effectively participate and bring their unique capacities to bear. Following these interviews, communication researchers shared findings and recommended that the group adopt a decentralized approach, a recommendation that was supported by resilience and organizations as complex systems literatures (Gunderson et al., 2008; Marion & Uhl-Bien, 2001; Morgan, 1997). This recommendation encouraged the group to move towards an organizational structure with a core executive leadership group in which each member also served on committees for each of the habitat targets. The transition helped alleviate the burden that was beginning to fall on the visionary leader and start to distribute the work more evenly across the group.

In addition to the role of the visionary leader, the diversity of leadership styles in the group, and the decentralization of leadership space there is at least one unique leadership capacity that was essential in the Partners' process and that connects back to the theme of common sense in rough seas. Elaine describes how her commitment to keep coming back was enabled by a commitment to humility:

> *Elaine: You have to get buy in from all sorts of folks. Again it all comes down to communication and effort. That's where the kind of stubbornness from a local Maine population. I don't mean that in a derogatory way but they've had to be otherwise they would have maintained absolutely no identity of their own, historically. They've had to be tough. It's hard to earn a living out here.*
>
> *But that stubbornness takes a certain amount of humility to deal with if you actually want to progress. An old-fashioned word: humility. I'm proud of that one.*

This characterization begs the question: what is humility? Returning to the first process commitment that difference is an inevitable and necessary condition and that common sense as a space of mutual vulnerability, we see humility as a stance that embraces mutual vulnerability and accepts it as a source of strength. It is evident in the description that Elaine provides here: the ability to persist relies on humility, a stance of openness dependent on mutual vulnerabilities. There is a mutual recognition that the people with whom she is intra-acting have their own sets of life experiences that condition the way they are and how they interact. Humility as a leadership characteristic is about remaining open to influence as part of the commitment to keep coming back. From this dynamic stance, capacities for working the tides may find a branch on which to take hold.

3.7. Becoming Tidal: A Conclusion

The Partners process depended on working the tides which included the recognition that the generative potential in difference can be enhanced by checking the tide charts as a way to understand and encourage diversity in participation; creating swirls; working with boundary objects; and by maintaining the commitment to keep coming back through diverse leadership dimensions. Aside from all this capacity, where does working the tides get us in terms of sustainability? There are multiple examples we could provide as evidence for our sustainability trajectory, but those we describe both

occurred within the final days of this dissertation writing in mid-November, 2013. These provide compelling evidence that working the tides matters, meaning working the tides *is* material and sustainable. Checking the tide charts brought specific perspectives to bear on the planning process. Miradi software also guided the group to focus on some materials and not others in their planning. Of the many sustainability values that the Partners could have selected, they chose intertidal mudflats and eel grass. Based on their assessments in the atlas, interviews with stakeholders, and other intra-actions with the plants, clams, and mud the group identified the goals of restoring eel grass to coverage observed in 1996 from flyover data from the Department of Marine Resources. They also identified the goal of opening all 610 closed clam flats in Frenchman Bay. We consider each of these briefly here and then conclude with how these emerging material assemblages connect with sustainability.

The eel grass restoration efforts are part of a long-term commitment at the Mount Desert Island Biological Laboratory (MDIBL) to work with students and community volunteers to plant eel grass. Their efforts were resulting in marked increases in population abundance in their restoration areas (Disney & Kidder, 2010), a success that was folded within the Partners' process. Then during the summer of 2013 eel grass in the Bay virtually disappeared. No one is sure the exact cause(s), which is understandable given the previous discussion of complexity, intra-action, and causation. This does not mean that eel grass restoration work in the Bay is over. Within the final weeks of writing this chapter, MDIBL announced that they received a major grant award in the hundreds of thousands of dollars to continue and expand their efforts to restore eel grass (Bowers, 2013). For now, they will continue to work towards eel grass restoration. The grant

participates but does not ultimately control what will come of these intra-actions in the changing tides.

The second example draws from the 610 project which ultimately aims to open all 610 acres of restricted clam flats in the Bay. As of this writing, the 610 project has not yet resulted in opening any closed clam flat. However, within this project, the shellfish committee has created a closer working relationship with the Department of Marine Resources. They have gone out on the mudflats together to survey clam densities in closed areas. And the committee now has a letter in draft that they will submit to the town selectboard to work with town officials to fix the leaky septic systems. In the letter they wrote the week of November 15th, 2013 the clam harvester liaison for the project said "We are striving for clean water." This striving is resulting in materials that trace a path towards clam flats that are healthy, productive, and accessible for harvesters work the tides.

Clearly, from how we described these "success" neither eel grass restoration nor opening closed clam flats are direct routes and we do not expect a cause-effect relationship. Instead, we are collectively conditioning this outcome through multiple strategic interventions. By working the tides, we are finding ways to become tidal: to work with rough seas, check the tide charts, intervene and navigate wherever possible, and to keep coming back again and again. The Partners are accomplishing their resilience mission by remaining dynamic and responsive and working with the world as it changes. Becoming tidal is how sustainability enfolds.

CHAPTER 4

RESILIENCE AS DISCOURSE: BREAKING DOWN THE BOX

4.1. Introduction

Resilience is an emerging way to think about and act to protect ecosystems and promote human well-being. As a frame, resilience is increasingly deployed in news stories, funding initiatives, conservation organization mission statements, and academic knowledge production systems. As a set of activities, resilience has come to refer to actions with flexible yet recognizable goals: resist, persist, and get or bounce back. Resilience is often paired with discussions of crisis, a linkage that invites a need for critical analyses to identify the stakes and, when necessary, promote alternatives (Milstein & Kroløkke, 2012; Peterson, 1997; Schwarze, 2007). A discursive analysis *of* resilience "foregrounds the material conditions of ecological degradation as well as the social/symbolic efforts to shape the meaning of those conditions as a primary subject matter" (Schwarze, 2007, p. 94). I bring environmental communication to resilience to offer an understanding of how language and other materials participate in and shape responses to dynamic change. I argue that resilience as a discourse draws boundaries around what becomes possible in the world as we continually adapt and transform. Understanding the material and constitutive dimension of these boundaries may help transform myriad relationships within interconnected systems so that resilience and sustainability can do more and better work in and with the world (Kinsella, 2007; Schwarze, 2007).

Resilience requires our attention because it is it is popping up with increasing frequency (Zolli, 2013). Resilience as a body of statements circulates in diverse media, grant funding, and organizational missions as the following examples show. The term

resilience is increasingly used to frame newspaper stories in which journalists describe the persistence of individuals and communities as they cope with natural and human-induced changes (Zolli, 2012). Though seemingly colloquial, the first two examples are representative of a much broader pattern in resilience framing. In one story from a popular online news site, a family kept a small tortoise as a pet. When the family renovated their house in 1982, the tortoise disappeared and the family assumed that she escaped through an open door, never to be seen again. Thirty years later, the family moved out of the house and discovered that the tortoise had been trapped, alive, in a cardboard box for more than three decades. The story concluded "in the end, it's hard not to be impressed with the resiliency of life and the slow-and-steady approach to survival taken by tortoises--both in living with us, and perhaps sometimes in spite of it" (Messenger, 2013). This pattern, in which sheer persistence is linked with resilience and where humans and nature are held in oppositions, repeats in an article drawn from Farmers Weekly in April, 2013 (Elder, 2013). This article describes dying flocks of sheep, failed crops, and other devastating consequences of climate change. In the story a spirit of resilience emerged in the face of these hardships where "the aim is simply to get through lambing and live to fight another day. Our troubles are down to the weather and it's nobody's fault" (Elder, 2013, pg. 1). To find ways to cope with living in a box and to simply live to fight another day sets resilience on a course of sheer persistence, despite all suffering, within an environment continuously characterized by impending crisis where "it's nobody's fault" (Massumi, 2009).

Resilience is also a growing commitment in state and federal funding initiatives, as organizations aim to reduce vulnerability, persist through emergencies, and rebuild

following all manner of disaster. The Rockefeller Foundation demonstrates this when it teamed up with the Federal Emergency Management Agency (FEMA) to launch the *Community Resilience Innovation Challenge* and more recently the *100 Resilient Cities Centennial Challenge*, to which they are committing $100 million dollars to build global urban resilience. This commitment is echoed in requests for proposals from the United States Department of Agriculture's (USDA) *Disaster Resilience for Rural Communities*, the National Ocean and Atmospheric Administration's (NOAA) Sea Grant programs, the Doris Duke Charitable Foundation's strategic funding for climate change adaptation, and OXFAM's business collaboration campaign to Promote Resilience and Environmental Preparedness (PREP), among other efforts. Substantial amounts of money are currently being funneled into efforts to promote resilience around the world.

Finally, resilience is a stated mission for groups working to promote the health and survivability of social and natural communities (Walker & Salt, 2006; Wilson, 2012; Zolli & Healy, 2012). The Frenchman Bay Partners, a collaborative group using a conservation action planning process on the coast of Maine, provides one example as they work to "ensure that the Frenchman Bay area is ecologically, economically, and socially healthy and resilient in the face of future challenges" (http://www.frenchmanbaypartners.org/). Researchers study and contribute to resilience efforts, like in the Partners and many other contexts, as evidenced by the vast body of work housed in online sites such as Ecology and Society, the International Resilience Alliance, Commonwealth Scientific and Industrial Research Organisation (CSIRO), and the Stockholm Resilience Centre. It is these latter sites and the texts they contain which constitute a central focus in this critical analysis of resilience, though I also draw from

news media, government documents, and my own experience. After I work through this critical analysis, I return to research with the Frenchman Bay Partners to illustrate how this group works within the constraints of the discourse and, more importantly, how the Partners also push the margins of resilience to create new conditions of possibility.

4.2. Resilience as Conditions of Possibility

In each of the above examples, the drive towards resilience aims to reduce vulnerability. The goal is for communities, ecosystems, and individuals to persist in an environment characterized by present and impending crises (Walker & Salt, 2006). The capacity to respond in times of crisis and change is promoted when we learn from each other and from diverse ways of knowing the world (Berkes, Colding, & Folke, 2003); develop social networks, social memory, and flexible institutions (Bodin & Prell, 2011; Chapin et al., 2009); and manage complex systems to the extent possible and in iterative cycles of acting and reflecting (Folke et al., 2002). Communication through language is fundamental to these adaptive capacities (Goldstein, 2012). It is through language that much social learning, system management, and innovation is achieved.

However, language has at least two sides: the visible utterance and the invisible outside (Foucault, 1998). It is at the invisible edge that we encounter

> the power of discourse. In other words, language in so far as it represents--language that names, patterns, combines and connects and disconnects things as it makes them visible in the transparency of words…Where there is discourse, representations are laid out and juxtaposed; and things are grouped together and articulated. (Foucault, 1970, p. 311)

Language, as we know, is not an empty vessel of meaning. Instead, language provides the choices available for how, in this case, we *become* resilient. When we follow the threads of the various representations of resilience, as being stuck in a box for 30 years; as surviving to fight another day; as the antonym of vulnerability; as occurring within interlinked social-ecological systems but where the social is still held as distinct from the ecological, we can begin to see resilience as more than its representations. By paying attention to representations, we can approach them as "one form of mediation in a changing ensemble of forms" (Stormer, 2010, p. 10) in which language and practices together create a *folded* boundary around what is imagined possible.

In this folded space, resilience discourse follows rules that guide symbols and practices to organize responsiveness. Importantly discourse is not the same as language nor is it a reference towards the linguistic and related grammars, conversations, and speech making. This is a mistake of

> representationalist thinking. Discourse is not what is said; it is that which constrains and enables what can be said. Discursive practices define what counts as meaningful statements…[which] emerge from a field of possibilities. This field of possibilities is not static or singular but rather is a dynamic and contingent multiplicity. (Barad, 2007, p. 146)

The practices of discourse produce a suite of meanings and logics for what comes to be recognized as the thing-to-be-known, as resilience. This project digs into the history of ideas about resilience to focus on the statements: the centers of authority, objects and practices, ordering strategies, and contradictions that construct the "field of strategic possibilities" (Foucault, 1972, p. 37). This analysis demonstrates the stakes when

resilience comes to be defined in particular ways, such as when it is articulated with coping and survivability, as dialectic to vulnerability, and when it reproduces constructs like "social" and "ecological." I ask: how does entrapment in a box come to be known as resilience? What is the history of ideas about resilience that allow this coherence? How might we compose the discourse differently such that a more dynamic, inclusive, and *sustainable* sense of resilience becomes possible?

The transformative intention in this project is a kind of *skunkworks*, to use a term woven into the discourse (Berkes & Ross, 2013; Goldstein, 2008; Gunderson, 1999; Holling, 2001; Sendzimir, Magnuszewski, Flachner, Balogh, & Molnar, 2008). Skunkworks are shadow groups that operate in informal spaces of transformation "where new ideas arise and flourish. It is these 'skunkworks' who explore flexible opportunities for resolving resource issues, devise alternative designs and tests of policy, and create ways to foster social learning" (Gunderson, 1999, p. 7). In one of many threads in this analysis, I followed a citation for skunkworks from Arun Agrawal's (2005) book *Environmentality* through manuscripts in *Conservation Ecology* and *Ecology and Society* by key resilience theorists, Lance Gunderson (1999) and C.S. Holling (2001), to a Wikipedia entry describing the cartoon strip Lil' Abner featuring a distillery making a potent blend called kickapoo joy juice made from worn shoes and dead skunks. From there, the search ended on the other side of a hyperlink telling me that Lockheed Martin further popularized the term to describe their covert development of the "Shooting Star," a fighter jet that became the first American jet fighter to "score a kill."

At the same time this potent metaphor calls up associations of creation, innovation, and transformation, it also traces our military-industrial political ecology in

which skunkworks are places that support the development of military technologies, economic growth, and human warfare (Latour, 2004). This tension is inescapable and the archaeological project is not to resolve it. Instead, the project illuminates these linkages so that our current spaces of becoming, through language, are made clear to us. From this space of seeing in which thought is made visible, a "task is thereby set for thought: that of contesting the origin of things, but of contesting it in order to give it a foundation" (Foucault, 1970, p. 332). It is from this foundation that we might slip into a potential but as yet unrealized space (Whitehead, 1978).

4.3. Resilience, Crisis, and Environmental Communication

Resilience thinking, like environmental communication, takes seriously the multiple crises of planetary degradation (Cox, 2007; Folke et al., 2010; Walker & Salt, 2006). Resilience thinking is a lens on complex ecological and social interactions that offers an "alternative perspective to the equilibrium-centered theories and models that guide management actions in many resource systems" (Gunderson, Holling, & Allen, 2010, pp. 423-424) to address these socio-material perturbations, these crises. Resilience begins with the assumption that healthy human societies are nested within intact ecosystems and that relationships within these SESs are inherently complex and non-linear (Berkes, Folke, & Colding, 2000; Folke et al., 2010). Resilience thinking as a "mind space" is a replacement for paradigms where the human is separate from and completely in control of ecological systems (Walker & Salt, 2006, 2012). This orientation intends to move beyond panacea approaches in ecosystem management (Ostrom, Janssen, & Anderies, 2007) to adaptive, reflective, and transformative processes for social and ecological sustainability (Walker et al., 2004).

I begin with a brief discussion of my critical discourse methods, drawing from Foucauldian (1972) archaeology. I then identify the two primary problems with how resilience as discourse shapes conditions of possibility: 1) the lack of attention to itself as discourse and, 2) the resulting constraints on who acts and with what agency that limits capacity and collective response in situations of dynamic change. I start with the problems in the spirit of "enacting a problem-posing, problem-solving mode of inquiry that, ultimately, would model the kinds of communication needed to adequately address the problems of ecological degradation" (Schwarze, 2007, p. 97). Working from the core problems, I describe discursive origins in ecology, ontologies, visual objects, and dialectical ordering strategies that continually shape and (re)produce these constrained conditions. I then propose alternative material arrangements as a step towards breaking down the box around current possibilities for self-understanding and action. The way in which resilience helps organize our modes of being requires critical analysis so that this discourse *of* crisis and coping transitions to more fully become *with* and *for* sustainability (Schwarze, 2007).

4.4. A Curious Blend of Methods

Using archaeological method, I analyzed the interwoven system of academic publishing sites; key scholarly texts; open-source journals; websites, blogs, print and popular media sources; and, to a lesser extent, personal experience in multi-year ethnographic projects with sustainability-focused organizations (Table 4.1). Archaeology is a systematic description of a body of statements and focuses on at least four features: regularities, comparative facts, contradictions, and transformations (Foucault, 1972). Table 4.2 provides a more detailed summary of the foci, questions, artifacts, and

subsequent observations that guided this analysis. The *regularity of statements* is revealed by examining the rules that set up the logic and how the logic then constructs the practices and the objects to which they refer. *Comparative facts* interrogate strategies that order the meaning. When a discourse tries to establish regularities within a non-linear complex assemblage, *contradictions* arise. Contradictions are points of tension in the discourse and are observed in who resists and how this resistance arises as sites of struggle. Contradictions are also revealed by considering alternative explanations hidden from view. Finally, archaeology "is a practice with its own forms of sequence and succession" (Foucault, 1970, p. 169) which holds at its unstable center change and *transformations*. In the discussion of transformations, I describe those that I observe occurring within the discourse, such as the movement towards open source publishing and emergence in the humanities. I conclude with proposed transformations based on this analysis and my embodied experience of the discourse.

Table 4.1. Representative summary of primary sources, associated organizations, and websites.

Sources	Titles, organizations, & web address
Academic citation indices, open source journals, and databases; search term "resilience"	– Databases: LexisNexis *Academic* and Web of Science – Ecology and Society, http://www.ecologyandsociety.org/ – Resilience: A journal of the environmental humanities, http://www.resiliencejournal.org/
Organizations	– Resilience Alliance, http://www.resalliance.org/ – Thresholds database of abstracts: Resilience Alliance and Santa Fe Institute. 2004. Thresholds and alternate states in ecological and social-ecological systems. Resilience Alliance. (Online.) URL: http://www.resalliance.org/index.php?id=183. – Stockholm Resilience Centre, http://www.stockholmresilience.org/ – Frenchman Bay Partners, http://www.frenchmanbaypartners.org/ – Sustainability Solutions Initiative (SSI), http://www.umaine.edu/sustainabilitysolutions/
Representative scholarly and popular texts	– Cumming, G. S. (2011). *Spatial resilience in social-ecological systems*. New York: Springer. – Goldstein, B. E. (2012). *Collaborative resilience: moving through crisis to opportunity*. Cambridge, MA: MIT Press. – Gunderson, L. H., Allen, C. R., & Holling, C. S. (2010). *Foundations of ecological resilience*. Washington, D.C.: Island Press. – Walker, B. H., & Salt, D. A. (2006). *Resilience thinking: sustaining ecosystems and people in a changing world*: Island Press. – Zolli, A., & Healy, A. M. (2012). *Resilience: why things bounce back*: Free Press.

Table 4.2. Summary of the archaeology, including points of focus within the discourse, guiding questions, and primary observations of discursive artifacts such as authorship, objects, strategies, and other features.

Points of focus	Guiding questions	Artifacts
Regularities	– What is logical and why? – How does the logic construct the practices and the objects to which they refer?	– Locus of emergence in ecology – Authorship in natural and physical sciences – Systems ontologies: cybernetic and complex adaptive systems (CAS) – Post-positivist epistemology, quantitative emphasis – Visual models: Basins of attraction
Comparative facts	– What are the strategies that order the meaning?	– Dialectical relationships: social-ecological, resilience-vulnerability
Contradictions	– What are the sites of struggle? – Who resists and what do they say?	– Observed tension within the discourse – Negotiations around the regularities and comparative facts – Highlight contradictions within discussion of regularities and comparative facts
Transformations	– Where is there observed change? – What emerges from these folded sites?	– Ethnographic observations – Open source publishing – Humanities emergence – Materiality and capacity

This analysis began with a series of readings assigned based on their prominence in the field in a sustainability science course I took during my first semester of graduate school (Folke et al., 2010; Lansing, 2003; Walker et al., 2004). Extending from these first texts, I searched Web of Science using the term "resilience." Of the more than 17,500 hits, I reviewed top papers by total number of citations, starting with Holling's (1973) paper which received the highest number of citations and those frequently cited papers that also referenced his work (Carpenter, Walker, Anderies, & Abel, 2001; Folke et al., 2004; Scheffer, Carptenter, Foley, Folke, & Walker, 2001; Turner et al., 2003; Walker et al., 2004). I searched Ecology and Society using the keyword "resilience" and selectively reviewed the 220 manuscripts that used this term in their texts. I read and analyzed key texts listed on the Resilience Alliance website and frequently referenced in articles (Berkes et al., 2003; Cumming, 2011; Gunderson, Allen, & Holling, 2010; Gunderson & Holling, 2001; Walker & Salt, 2006, 2012). Recognizing that resilience as a discourse transcends "resilience" as a term, I examined 102 abstracts in the Thresholds Database listed on the Resilience Alliance website. Many of these papers did not use the term resilience in the title nor in the keywords, yet these studies were offered as knowledge about resilience on this site.

To better understand how resilience circulates in popular press, I searched major U.S. newspapers and magazines from the last year in LexisNexis using the term "resilience" which resulted in 195 newspaper and magazine articles. I compared frames within these stories to patterns observed in academic sites. My analysis also focused on popular sources, including Zolli's (2012) *Resilience: Why things bounce back*, his blog (Zolli, 2013), and an article published in multiple sites (Zolli, 2012). Because discourse

relies on institutions where it is "both renewed and reinforced by a whole strata of practices such as pedagogy, of course; and the system of books, publishing, libraries; learned societies in the past and laboratories now" (Foucault, 2000, p. 1463), I put the analysis of texts in conversation with my subjective experience in institutions that operate within the formation. I drew from my experiences as a researcher and student studying communication in settings where resilience and sustainability are stated missions, namely in the Frenchman Bay Partners and to a lesser extent in the Sustainability Solutions Initiative (Table 4.1). The analysis of these multiple texts treats discourse as an entangled web of interpositivities "whose limits and points of intersection cannot be fixed in a single operation" (Foucault, 1972, p. 159) and whose productive potential arises from going into the folds and creating openings from within.

4.5. Problems in a Limited Field of Possibilities

Approaching resilience as discourse, I identify two primary problems with how this system "names, patterns, combines, and connects and disconnects things as it makes them visible" (Foucault, 1970, p. 311). These problems connect with how resilience thinking as a discourse conditions what comes to be seen as possible in our response to change, who acts, and with what agency. These problems matter because they constrain options for material and symbolic invention, recursive memory strategies (Stormer, 2013), and styles of being in and with the world that resilience and sustainability may intend to foster (Stormer & McGreavy, Under review). I foreground these two problems and then provide a more detailed description of the artifacts in the archaeology and how they reproduce these problems. I put these problems in conversation with observations of similar patterns in rhetorical analyses of science (Kinsella, 2007; Schwarze, 2007);

sustainability and sustainable development (Peterson, 1997); climate change tipping points (Russill, 2008); and human-nature dialectics (Milstein, 2009; Milstein & Kroløkke, 2012).

First, aside from a few notable exceptions (Berkes, 2008; Berkes & Folke, 2000; Goldstein, 2012; Holling, 1973), there is a general lack of attention to how resilience operates as a discourse to construct logic and define modes of response. White (1973) describes this pattern within the sciences as a "failure to recognize the extent to which they are each captive of language itself, their failure to see language as a problem" (p. 45). The lack of attention to science as discourse correspondingly occurs in sustainability and sustainable development (Peterson, 1997). In sustainable development, nature and what is considered to be natural law "is viewed not as part of a socially constructed view of progress but, instead, as part of an essentially non-human logic, located in biological systems" (Peterson, 1997, p. 31). The mask of objectivity obscures the normativity of what comes to be associated with resilience. The ability to cope in the face of crisis runs the risk of promoting "[human] suffering and misery as necessary components of a larger natural order" (Peterson, 1997, p. 28). When resilience is conceived as an inherent property of systems that enables coping with change, we must consider coping as a normative strategy that limits our ability to see other possibilities for response (Peterson, 1997; Russill, 2008).

Second, there are recurrent objects and organizing strategies that attempt to define who participates in resilience and with what agency. This narrow ordering limits more transformative relationships among humans and environments (Bennett, 2010; Milstein & Kroløkke, 2012). Kinsella (2007), focusing on bodily encounters with the world, asks us

to consider "how human interactions with the natural environment force us to confront its obdurate, recalcitrant materiality" (p. 197). When we simultaneously attend to how language participates in constructing our sense of order–like in the dialectic human-nature–and how the world pushes back against our persistent attempts to order it in these ways, we invite the question of how to dwell differently *with* the world. From this orientation, we might recognize that our dwelling relies on the participation of diverse material entities within vibrant assemblages (Barad, 2007; Bennett, 2010). Adopting this stance changes the conditions of possibility for capacities of all kinds, including language (Whatmore, 2006).

The lack of attention to the material and constitutive dimension of language and the persistent ordering strategies that create and reinforce division and hierarchy constrain sources of understanding, creative insight, and capacities for innovation. However, this project is not a search for a new positivity. Instead, it is an attempt to slip into a space which

> ceases to follow the slope of self-interiorizing thought and, addressing the very being of language, returns thought to the outside; from that moment, in a single stroke, it becomes a meticulous narration of experiences, encounters, and improbable signs--language about the outside of all language, speech about the invisible side of words. (Foucault, 1998, p. 154)

This analysis helps shift resilience from a discourse of *crisis and coping* to one of *sustainable becoming* (Grosz, 2011; Schwarze, 2007). In this new mode dynamic and vulnerable responsiveness occurs within a process of material striving to produce emergent ethics and values–this is sustainability as process and value. This process and

these outcomes occur through dwelling in vibrant assemblage in which we can start to transcend the hyphenated spaces in social-ecological systems that have so long organized our modes of being (Milstein & Kroløkke, 2012; Peterson, Peterson, & Peterson, 2007; Williams, 1980). This fold, this crease in the box, is where I want to end up; but we have discursive terrain to explore before we get there.

4.6. Whose Property is This? Setting the Boundaries of Resilience

Resilience theorists generally describe resilience as a system's ability to cope with, adapt to, and shape changes that occur within defined SES boundaries (Carpenter et al., 2001; Folke et al., 2002; Holling, 2001; Turner et al., 2003; Walker et al., 2004). The Resilience Alliance, a key site that organizes and reinforces the production of knowledge about resilience, provides a representative summary:

> A resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added capacity of humans to anticipate and plan for the future. Humans are part of the natural world. We depend on ecological systems for our survival and we continuously impact the ecosystems in which we live from the local to global scale. Resilience is a property of these linked social-ecological systems (SES). (Resilience Alliance, 2002)

This characterization demonstrates the dominance of ecology as a foundation for explanations of complex interactions in SES. Descriptions of resilience generally begin with the concept of ecosystems and then include humans as agents affecting ecological change. Ecological and social interactions are functional, where resilience is a *property* of systems that promotes SES capacity "to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure and

feedbacks, and therefore identity, that is, the capacity to change in order to maintain the same identity" (Folke et al., 2010, p. 3). Efforts to reduce vulnerability and build capacities to withstand, rebuild, and get back to normative conditions enhance resilience as a property of these systems.

Resilience research relies heavily on case studies to demonstrate features that enhance functional properties and adaptive capacities (Anderies, Walker, & Kinzig, 2006; Berkes & Folke, 2000; Walker, Anderies, Kinzig, & Ryan, 2006; Walker & Salt, 2006, 2012). For example, a resilient shellfish economy depends on intertidal mudflats that are not contaminated by bacteria and toxic pollutants. The loosely connected network of clam harvesters and scientists is a property of this system that promotes collaborative decision making and their ability to sustain a specific yield of clams into the future (Bodin & Prell, 2011; Hanna, 2000; Janssen et al., 2006). In this case, network connections and collaborative decision making are the resilience-related properties that organize human responsiveness in systems. The mutual striving in which these groups−clam harvesters and scientists−come together to determine the clam yield that meets the needs of the present without compromising the ability of future generations to meet their needs is sustainability as process and identified value.

In another example, the resilience of a healthy lake SES depends on the ability to maintain or return to a regime characterized by clean water, controlled run-off, and a thriving tourist industry (Walker & Salt, 2006). This SES regime may rely on people in the community who hold memories of the lake before it was degraded which enable adaptive actions to get back to the desired conditions. In this case, the collective memory of the community is a resilience property, as is the ability of the lake to absorb additional

nutrient run-off, among other attributes. The threshold for a lake's ability to absorb phosphorus without switching into a state characterized by algae blooms and degraded water quality may be relatively defined based on previous ecological studies in comparable watersheds. However, how we define social "thresholds" for things like memory and learning and how these relate to maintaining a system enacts a particular mode of seeing the world. The threshold or tipping point lens on these interactions may mask more complex and potentially problematic dynamics (Russill, 2008).

Like in the threshold example, ecological concepts are often used to explain pre-defined social phenomena. I briefly focus on three that are central to resilience theory: communication, memory, and identity (Chapin et al., 2009). Communication, memory, and identity are social concepts that have been long theorized and reinterpreted in social sciences and humanities. The emergence of social science and humanities perspectives in resilience discourse is occurring, with economics, anthropology, and psychology leading the way for theorizing about human and more-than-human relationships (Berkes & Ross, 2013; Janssen, 2013).

In resilience and SES studies, communication as a form of human interaction is largely described as a linear process of information transmission. These discussions derive, in part, from economic capital and population ecology models of material, genetic, and information exchange (Carpenter, Brock, & Hanson, 1999; Janssen, 2013; Longstaff & Yang, 2008; Mitchell, 2009). Janssen's (2013) series of laboratory experiments provides a representative example of communication as information exchange. In these experiments, he manipulated the amount of information available to participants and from these derived conclusions about cooperation within SESs. He notes

"the *level of information* about the actions of others affects the level of cooperation. This seems related largely to *information* about the strategies participants are using. Previous studies did not include *communication* in which people could coordinate their activities" (Janssen, 2013, p. 2). I added the emphasis to demonstrate the linking of communication and information and how these were studied as drivers for social organization. This view of communication is informed, as seen in his reference list and selectively referenced here, by the disciplines of psychology (Kerr & Kaufman-Gilliland, 1994), economics (Buchan, Johnson, & Croson, 2006), and communication (Shankar & Pavitt, 2002)

In a similar vein to the information transmission, communication as memory is generally described as a type of storage capacity. In these discussions memory is a knowledge base or experiential grounding whose structure is relatively consistent and unchanging, much like a seed bank (Allen & Holling, 2010; Barthel, Folke, & Colding, 2010; Nyström & Folke, 2001; Tschakert & Dietrich, 2010). A clear example of how an ecological concept, in this case memory, is being applied to explain social phenomena is seen in Walker and Salt's (2012) comparison of forest patch dynamics and farm governance. They describe how forests may be destroyed by a fire, but if this forest community is at a "higher" scale–i.e. spatially connected through seed dispersal and/or storage mechanisms–then "the system as a whole as a 'memory'" and can regenerate the patch disturbance. In the following paragraph, they compare forest regeneration and memory to one where

> a farm may go bankrupt, for example, because of inappropriate land policy, but when it rebuilds (or a new farmer steps in), it is still constrained by those same

> policies…Top down influence can be positive as well as constraining and negative. Memory can be both good and bad. (Walker and Salt, 2012, p. 16)

In critical social theory, this latter set of circumstances is not described as memory. Instead, this is a clear example of bio-power, what Foucault (1980) refers to as "the numerous and diverse techniques for achieving the subjugation of bodies" (p. 140). The difference between memory and power matters for what those who adopt a "resilience frame of mind" come to see as an important point of focus for planning and response (Russill, 2008).

It is important to note that these characterizations of memory and identity as fixed and stable properties of the system is not uniform within the discourse (Goldstein, 2012; Loring, 2007). In resilience scholarship that draws from case studies with indigenous cultures, the discussion of memory and identity tends to be more dynamic. These accounts focus on how memory is continually reproduced through human connection to the land, narrative storytelling, and spiritual practices (Berkes, 2008). For example, Davidson-Hunt and Berkes (2003) describe social memory as "the collective creative palette of a society upon which individuals draw to be competent members of a society" (p. 2). Contradictions, in this case where memory and identity are not described as a fixed property, occur for most of the patterns I describe. Resilience is a diverse discourse with many threads so there are frequent contradictions to dominant patterns discursive objects and practices. However, these are generally positioned as a response to dominant constructs and therefore help identify the dimensions of the discourse.

4.7. Getting to the Centers

4.7.1. Origins and Authority: An Ecological Locus

To understand how resilience comes to be understood in these terms, namely as a property enhanced by capacities derived from communication, memory, identity and other functional interactions, it is important to examine who talks about resilience and with what authority. From these centers, the ontologies and associated objects and ordering strategies that define what *makes sense* follow (Foucault, 1972). The regularity of authorship in resilience includes a key surface of emergence, namely C.S. Holling's 1973 paper on *Resilience and the Stability of Ecological Systems*. This paper is a touchstone as demonstrated by the centrality of how other scholars describe it and by the more than 2,100 other papers in the Web of Science that reference this piece. B.H. Walker et al. (2006) demonstrate how scholars within the field characterize this early contribution in the first line of their paper: "The concept of resilience in ecological systems was introduced by C. S. (Buzz) Holling (1973), who published a classic paper in the *Annual Review of Ecology and Systematics* on the relationship between resilience and stability" (p. 1). In certain domains, and especially in areas of literature, philosophy and science, attribution of authorship creates and reinforces societies of discourse (Foucault, 2000). These societies then set the domain in which other authors construct their ideas.

Stemming from Holling's (1973) seminal paper and paying attention to authorship, there is a regularity with scholars such as Allen, Anderies, Berkes, Carpenter, Chapin, Cumming, Folke, Gunderson, Janssen, Kofinas, Ostrom and more appearing throughout the web of citations and as consequently demonstrated in the prevalence of their scholarship cited throughout this piece. A review of just a handful of these authors

reveals that they are largely, though not exclusively, male professors who hold Ph.D.'s and are associated with Universities or research institutions. An important exception to the trend of male authorship is the influential work by Elinor Ostrom (Ostrom, 1990, 2009). In 2009, Ostrom was awarded the Nobel Prize in Economics. Of the 73 people to have been awarded the Nobel Prize in economics since its inception in 1969, Ostrom was the first, and so far only, woman to have won this award which she shared with Oliver E. Williamson (http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/index.html).

Resilience scholars are also often affiliated with natural and physical sciences such as ecology, environmental studies, zoology, forestry, biology and environmental engineering. For example, *Ecology and Society*, which was founded by C.S. Holling and where Carl Folke and Lance Gunderson serve as editors is an important site for resilience research. Folke is Science Director at the Stockholm Resilience Centre and has a Ph.D. in Ecological Economics and Natural Resource Management from the Department of Systems Ecology at Stockholm University. Gunderson has undergraduate and graduate degrees in Botany and a Ph.D. in Environmental Engineering Sciences. The executive director of the Resilience Alliance, which publishes *Ecology and Society*, is Phil Taylor a professor in the Department of Biology at Acadia University who describes his central research questions as coming from the field of conservation biology. Brian Walker is Chair of the Board of the Resilience Alliance and a Research Fellow with CSIRO, which lists his interests as social ecological systems, global change in terrestrial ecosystems, environmental resource sustainability, and plant ecology.

The authority described here highlights how "expertise functions in a way to represent, collate, and stabilize what is known . . . producing the need for a particular kind of expertise" (Greene, 1999, p. 6). This extended summary is not to emphasize or question individuals' qualifications for publishing resilience scholarship but to reveal the grid of authority on which this scholarship builds. The locus in Holling's (1973) paper, the regularity in the scholarship that refers back to this touchstone, and the institutional structures and embodied scholarly practices associated with *Ecology and Society* and Resilience Alliance as sites that concentrate resilience scholarship are central features of the pattern. This is a discourse deeply embedded within the natural sciences. These beginnings and the continual (re)production of ideas that derive from ecology have implications for how others perform scholarship in this formation, including expected ontologies and visualizations.

4.7.2. Ontologies and Objects: Contradictions at the Level of Control

Resilience's coherence relies on accepting the ontology that objects function in relation to one another in complex and nested interconnections. Nothing in resilience makes sense without systems as a starting point for reality. Systems paradigms have made their way into a wide range of discursive formations with statements that trace their roots to engineering and physics. Holling (1973) describes these origins and their discursive implications in his keystone piece:

> Our traditions of analysis in theoretical and empirical ecology have been largely inherited from developments in classical physics and its applied variants. Inevitably, there has been a tendency to emphasize the quantitative rather than the qualitative, for it is important in this tradition to know not just that a quantity is

> larger than another quantity, but precisely how much larger…But this orientation may simply reflect an analytic approach developed in one area because it was useful and then transferred to another where it may not be. (p. 1)

Systems themselves do not represent a homogenous discourse, with multiple intersecting, overlapping and divergent objects and rules deserving of a more extensive analysis (Ramage & Shipp, 2009). Yet, if we consider just three systems discourses that intersect with resilience and influence the overall formation, namely ecosystems, cybernetic systems, and complex adaptive systems (CAS), the influence and emergent contradictions of systems perspectives is revealed.

While many resilience theorists situate their work within CAS, they largely do not acknowledge that there are multiple and sometimes contradictory orientations within CAS (Morgan, 1997; Ramage & Shipp, 2009). One of the key points of difference within CAS is the amount of control humans are assumed to have. Walker et al. (2004) provide a representative example of a view of CAS in which humans still exert considerable influence when they say "although the system as a whole self-organizes without intent, the capacities and intent of the human actors *strongly* influence the resilience and the trajectory of the SES" (emphasis added, p. 7). Metaphors also illustrate the finer assumptions about agency within systems, as Chapin et al. (2009) demonstrate when they describe an SES as being

> like a box or a board game, with explicit boundaries and rules, enabling us to quantify the amount of materials (for example, carbon, people, or money) in the system and the factors that influence their flows into, through, and out of the system (p. 9).

In these characterizations, the human is both embedded within *and* an autonomous entity able to exert an inordinate amount of influence over the system.

Contradictions at the level of control produce tensions in the discourse as different orientations to complex adaptive systems collide. The above examples from Walker et al. (2004) and Chapin et al. (2009) are more consistent with a cybernetic systems view, with Greek roots in the word *kybernetes,* meaning to steer (Mason & Davidson, 2008). The ability to get or bounce back following change to stay within a specified regime depends on humans as exceptional agents and their capacity, albeit incomplete, to steer the system. This assumption produces tension within the discourse as authors work with control in different ways, ranging from a fully complex adaptive system in which humans have a minimal amount of control to a cybernetic system in which humans maintain a degree of control at the helm. As I describe the following section, a view of the system in which capacity is derived from working with the world in vibrant material assemblage provokes an understanding that the world itself pushes back on the cybernetic ontology. This push back creates even wider openings for how we might compose ourselves differently as resilience seeks sustainability (Bennett, 2010; Latour, 2010).

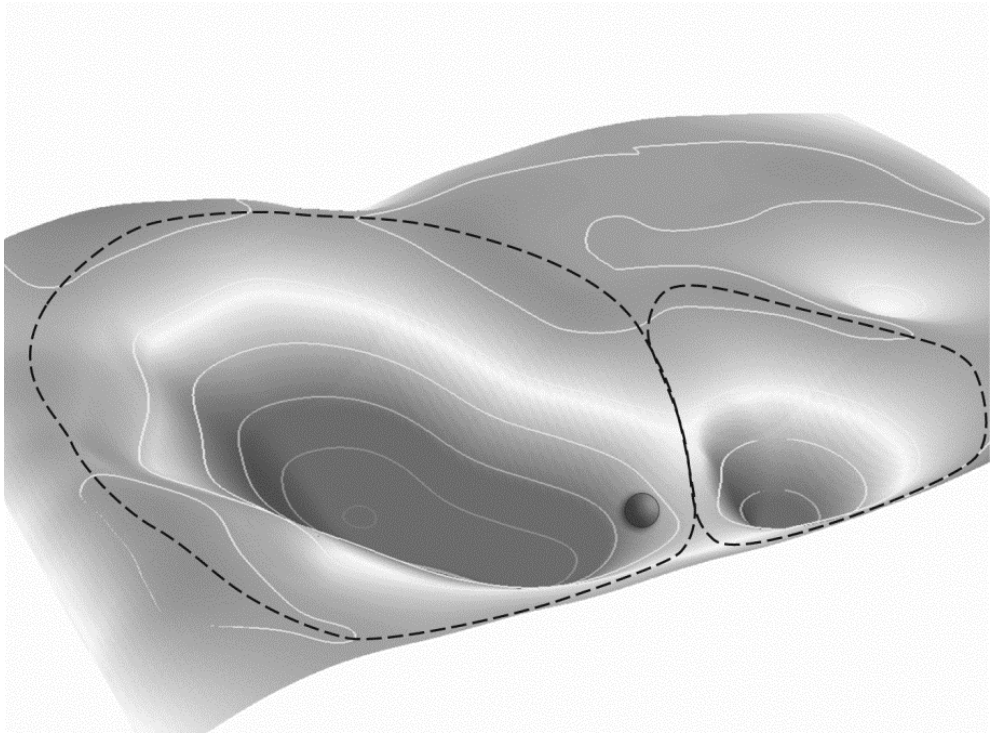

Figure 4.1. Basins of attraction visual model from Resilience Thinking, by Brian Walker & David Salt. Copyright © 2006 Brian Walker & David Salt. Reproduced by permission of Island Press, Washington, D.C. (See Appendix I for copyright agreement).

The underlying cybernetic ontology is also apparent in the basins of attraction visual model. There are several visuals that circulate in the discourse but the basin of attraction diagram is a key figure that also that traces to the locus, as Holling (1973) offered an early representation. The basins model depicts the SES landscape as a space of dynamic change and text accompanying this model emphasizes continuous fluctuations and shifts (Walker et al., 2004; Walker & Salt, 2006). Articulating associations with bathymetric lake maps, the basins of attraction model usually features two concave "pools" with sloped sides shown with topographic lines (Figure 4.1). A dotted line separates and encloses each basin. In one of the basins, a small dot is shown to indicate the state of the SES at any given moment. Though the diagram is static, the viewer is to imagine that the dot shifts throughout the plane space of the focal regime.

Basins of attraction are an important object that influences the regularity of this discourse and a clear demonstration of the underlying influence of physics in the constitution of this symbol, with its resemblance to wormholes and multi-dimensional space.

Visualizations like basins of attraction matter because they participate in the unfolding of ideas. Returning now to Russill's (2008) analysis, he demonstrates how discourse tipping point terminology functions in this way. His analysis shows how "tipping points" transcend the more obvious articulations of epidemic models of response to public health issues such as "Avian flu, SARS, West Nile virus, and bio-terrorist attack–[and] have proliferated widely as a sense-making device for events characterized by complexity, urgency and uncertainty" (p. 134). Much like basins and thresholds, tipping points as object and ordering strategy promote modes of response within a confined "epidemiological imaginary" (Russill, 2008, p. 135) in which public health responses then take precedence over other possible interventions and actions. Further, and in a situation that is analogous to how ecological functions are used to describe social interactions in resilience, confusion and contradictions emerge when tipping points are mobilized to "explain changes in physical processes, life systems, and social behavior. Such slippage is frequent in climate change discussions and, at worst, entails the reduction of complex social behavior to physical or biological models in a positivistic fashion" (Russill, 2008, p. 145). In this case, public health responses and preventative measures may be defined by simple cause and effect relationships. Focusing on the simple fixes may mask the ideologies, inequities, and other complex factors that also need to be addressed to effectively respond to climate change. Tipping point discourse,

and by extension systems ontologies and objects within resilience discourse, guide what comes to be seen as possible in situations of dynamic change (Russill, 2008).

What is currently possible in resilience as modes of response? The turtle in the box, the farmer surviving to lamb another day, and ball within the basin all share a similar feature in their respective responses. These are all responses that depend on recalcitrance, the ability to push back for persistence. When a variable changes, for example an increase in nutrients into a lake, a resilient system pushes back against or absorbs this change to maintain its identity. A system losing its resilience is one where the ability to push back against these changes is compromised to the point where its identity as a lake SES characterized by clean water and a tourist economy might shift to one characterized by turbid water and high unemployment. This new regime might then become highly resilient, i.e. resistant to further change, where the previous regime can never be restored. This situation is also known as hysteresis (Kinzig et al., 2006) and is one in which resilience is a continually deferred process of resistance to change.

A recalcitrant model of resilience is discursive, composed largely by the cybernetic systems model and visual objects that (re)produce this sense of the world. Goldstein (2012) addresses the discursivity of recalcitrance in bouncing ball model of change which is a manifestation of the basin concept when he argues "the metaphor is too simplistic, because the dynamics of a bouncing ball and a society in crisis are not the same" (p. 373). The definition Goldstein proposes is one which storytelling, narrative performance and other embodied practices would be included as legitimate epistemologies for resilience. These epistemologies do not assume stable identities. Instead, these modes of becoming approach the world and its myriad inhabitants as

composed of continually emerging multiplicities of dynamically changing identities. Following this line of thinking, a story of resilience is not a story of recalcitrance but one of continual responsiveness. As Pollock (2006), a narrative performance scholar, says a story of resilience is not

> a story until it is told; it is not told until it is heard; once it is heard, it changes—and becomes open to the beauty and frailties of more change; or; a story is not a story until it changes. Indeed, until it changes or until it changes someone else. (p. 93)

Recalcitrance and cyberneticism rely on the ability to push back and steer for change. Resilience as Goldstein (2012), Pollock (2006), and others conceive it relies on an openness, an affectability that are a source for more and better change (Davis, 2010; Rickert, 2013). As I show in the next section, reconfiguring the dialectic of resilience-vulnerability helps open up what becomes possible in mutual spaces of responsiveness. In these relations, capacity becomes more than resistance and coping.

However, this is not to press ahead without recognizing that there are stakes in the proposed shift from recalcitrance to a more open and dynamic responsiveness. Brand and Jax (2007) reveal these stakes they say:

> conceptual clarity and practical relevance are critically in danger. The original descriptive and ecological meaning of resilience is diluted as the term is used ambiguously and in a very wide extension…As a result, difficulties to operationalize and apply the concept of resilience within ecological science prevail. (p. 1)

The struggle evidenced in the series of quotations in this section goes beyond the

contestation about how to symbolize resilience. The stakes also extend to the material resources that may or may not be made available to specific people at particular institutions to produce scholarship about it. Responding to Brand and Jax (2007) directly through citation, Folke et al. (2010) argue that the discourse must be open to changes in perspective because "many of the serious, recurring problems in natural resource use and management stem precisely from the lack of recognition that ecosystems and the social systems that use and depend on them are inextricably linked" (p. 2). Unlike some discourse societies then, resilience is one in which there is space, as constrained as it may currently be, for environmental communication and related fields to bring insights to these inextricable linkages (Schwarze, 2007).

The contradictions that arise as the intersection of multiple ontologies and objects creates openings into which other ways of understanding the world may enter the formation (Berkes, 2008; Berkes & Ross, 2013; Goldstein, 2012). Instead of a basin, box, or board game, change might be understood as a river, following Heraclitus, in which each moment is a transition point between form and dissolution, where there is no attempt to get back to or stay within a stable domain (Kahn, 1979). Or, we might come to see these arrangements as atomic (Davison, 2008), as a creative and evolutionary drive of difference (Grosz, 2011), within a one-substance metaphysical organism (Whitehead, 1978). What is at issue here is not that one model of change is more accurate than another but that each has implications for what becomes (Barad, 2007). Being aware of the productive quality of these objects and strategies enables the recognition that we might adopt a different navigation strategy in a boat that we can't ever seem to steer by ourselves.

4.8. How Form Follows Function

When resilience is a property based on functional relationships within systems, humans are part of the natural world yet are also held distinct by our dependence and impact on these systems. In a cybernetic ontology, humans largely define the boundaries and steer to stay within them. In CAS, the ability to adapt is a human function, though the boundaries may be less well defined and our ability to control not as complete. These ontologies reaffirm the dialectical relationship that defines the human as connected to but also distinct within the world (Milstein & Kroløkke, 2012). Resilience theorists sometimes recognize this dialectic, shown when Berkes et al. (2000) note "the delineation between social and natural systems is artificial and arbitrary. Such views, however, are not yet accepted in conventional ecology and social science" (p. 4). This acknowledgement is an opportunity to identify new modes that start with a recognition that these delineations are, at least in part, discursive. Resilience is a discourse woven through with dialectics and the two most prominent and mutually reinforcing are social-ecological and resilience-vulnerability. Though Berkes and Folke (2000) acknowledge the constructedness of social-ecological and they attempt to set the problem aside by making the claim that sciences are not ready to think beyond these ordering strategies, theorists in environmental communication offers analytics for taking this necessary step (Kinsella, 2007; Milstein, 2009; Milstein & Kroløkke, 2012; Rogers, 1998).

Social-ecological and resilience-vulnerability correspond with longstanding discussions of the dialectics of human-nature (Peterson et al., 2007; Rogers, 1998; Williams, 1980) and more recent *in situ* analyses of mastery-harmony and othering-connection (Milstein, 2009). Where social-ecological has been a sustained focus of

critical inquiry in environmental communication (Milstein, 2009; Rogers, 1998; Williams, 1980), resilience-vulnerability has only more recently been examined but is one in which vulnerability is always already a weakness (Stormer & McGreavy, Under review). I explore the limits of dialectics to set up a proposed transformation in line with Milstein and Kroløkke (2012) who call for a transcorporeality that brings vulnerability and resilience together for a more material vibrant assemblage for enhanced capacities for sustainability (Bennett, 2010; Latour, 2010).

The hyphenated linking of social-ecological is a response to exclusionary, linear models to manage ecosystems for stability (Gunderson, Holling, et al., 2010). The addition of social to the ecological attempts to create a more integrated and holistic view of ecosystems in which humans are nested as unique actors. The hyphen intends to emphasize a "humans-in-nature perspective" (Folke et al., 2010, p. 3). I embrace the transformation within ecology to include humans, as this opens opportunities for research and practice on an expanded set of complex interconnections. However, this stance maintains humans and nature as relatively stable, fixed, and oppositional categories. Pairing humans *and* nature or humans *in* nature depends on a deferred series of dialectics to maintain this stability (Derrida, 1977). Most prominently, this pairing depends on the dialectic of othering-connection (Milstein, 2009). When discourse names the social, the implication is that-which-is-not-natural. The ability to negate is productive in the sense that while it produces the formation "natural" it removes this formation from the concept "social" establishing them as comparative domains. This ordering strategy reifies the distance between the so-called social and ecological that resilience scholars may seek to cross.

Similar to the way in which social and ecological are held as fundamentally distinct, vulnerability is also always positioned as antonymic to resilience (Adger, 2003, 2006). Drawing on risk communication literature (Kasperson & Kasperson, 2001), Folke et al. (2002) provide a representative example when they define vulnerability as, "the flip side of resilience: when a social or ecological system loses resilience it becomes vulnerable to change that previously could be absorbed" (pg. 13). When vulnerability is always positioned as a negative risk associated with affectability, coping becomes the dominant modes of response to change. Resilience as recalcitrance, coping, and sheer persistence relies on vulnerability as harm. It is in this space that we come to see being trapped in a box for 30 years and surviving to lamb another day despite all odds as resilience, as opposed to other normative constructs like suffering or misery.

Following Goldstein (2012), if we consider resilience not as recalcitrance and coping but as a more open and dynamic responsiveness, we must also reconfigure resilience's dialectic relationship with vulnerability. Vulnerability as a space of potentiality opens the multiple possibilities emergent from responsiveness. These response-abilities might result in coping but they might also and simultaneously open other modes of response as well. Approaching resilience as a dynamic responsiveness dependent on affectability, on our *mutual* vulnerabilities, helps us consider where our capacities to cope, learn, adapt, and transform come from (Stormer & McGreavy, Under review).

Pressing further, we might also adopt a critical stance to imagine, from our sense of the turtle's perspective, the embodied experience of being trapped in box for 30 years and the kinds of stories she might tell so that this kind of entrapment doesn't happen

again (Bennett, 2010; Carbaugh, 2007). In doing so, we could enhance our attunement "to those other expressive systems, to what each is saying, to us in its own way, and then we might learn to speak better, in our own words, on its behalf, as a result of this process" (Carbaugh, 2007, p. 68). From this standpoint, resilience is no longer a functional property based on resistance as the dominant mode of response. Resilience is instead an open affectability characterized by dynamic and emergent modes of becoming in and with the world in a transcorporeal, material assemblage (Bennett, 2010; Milstein & Kroløkke, 2012). In this assemblage, collective striving for sustainability becomes less about reducing uncertainty and more about conditioning new potentialities for continual sustainable transformation.

4.9. Trans-form-ation

Change occurs in the space where points of coherence and rupture fold into "differences, distances, substitutions and transformations" within the discourse (Foucault, 1972, p. 37). There are emerging changes in resilience discourse that address and in some ways are starting to reconfigure the problems identified at the beginning, namely the lack of attention to resilience as discourse and the constitutive boundaries for who has capacity to act and the limits for creativity and transformation. Having lived this discourse for more than three years, I observed several key transformations and identified additional opportunities for more still. Here I describe these transformations by briefly comparing resilience with other discourse societies. I then work through observations of how different types of participants in the discourse modify its body of statements. Finally, in the spirit of skunkworks I create my own rupture by directing attention to what the *skunk* and other more-than-human materials might do in the composition of potent

innovation (Bennett, 2010; Goldstein, 2008; Latour, 2010; Whatmore, 2006). In doing so, I demonstrate how this discipline of resilience can invite discursive and material change (Schwarze, 2007).

Resilience as a system of knowledge production is markedly different from other societies of discourse in its commitment to provide open access to ideas that circulate in this formation. All of the major sites that concentrate resilience scholarship, including *Ecology and Society*, the Resilience Alliance, and the Stockholm Resilience Centre provide open access to published articles, abstracts, summaries of key concepts, lists of relevant books, scientist and practitioner workbooks, blog posts, and more. Throughout this analysis, I have worked from the standpoint of what environmental communication can do to generate new insights within resilience. But environmental communication can also learn from resilience's commitment to open access, shared learning, and democratic language practices (Peterson et al., 2007; Schwarze, 2007).

The recent emergence of *Resilience: A Journal of the Environmental Humanities* is evidence of the search for new ways to organize modes of response (Foote & LeMenager, 2013). The way in which this website defines resilience starts to address the lack of acknowledgement of discourse and constraints on participation. In this alternate definition, resilience is "a mode of seeing, describing, and analyzing the cultural texts, events, and political and social desires shaping our current and possible relationships to the analytic category of environmentalism" (Foote & LeMenager, 2013). Following this definition, website visitors are invited to share their meanings of resilience, presumably as "an invitation to think both against and with other disciplines, to improvise a common conversation, to stake out and describe an environmental sensibility that can account for

transformations in key terms like ‘knowledge,’ ‘nature,’ ‘humanities,’ and ‘culture’” (Foote & LeMenager, 2013). The push for new insights and creativity as seen here and in other artifacts shows resilience discourse as a formation in which ruptures and transformations are possible. The material constitution of this box, this discourse, was composed by the authors who from the earliest articulation also acknowledged the possible constraints of composing resilience as quantitative, as based in the discipline of ecology with its lineage in physics and mathematics (Holling, 1973). These acknowledgements help create the space for subsequent transformation. Authors as centers of authority consistently pushed back against attempts to maintain resilience as solely an ecological concept within scientific domain (Folke et al., 2010). In these and other statements resilience discourse, as a box, is currently composed not of metal but of cardboard, offering a more flexible and transformable space for sustainability to unfold.

4.10. Conclusion: A Potential Fold

In this analysis, I started with the problem of how resilience neglects its discursive constitution and ignores the regularities, comparative facts, and contradictions that condition what resilience becomes. I described the implications of these problems in terms of limits on capacities for action and transformation. I then worked through the artifacts that contribute to these problems in how resilience became a functional property of systems reliant on objects that help construct resistance as the dominant mode of response. From this, coping is a normatively and narrowly defined option for what becomes possible within resilience. I took this box of ideas about resilience and creased the edges so first, its boundaries became recognizable and second, we might create new folds for transformative insight and action. Now I turn to more directly to my embodied

experience of the discourse with my work with the Frenchman Bay Partners, a group I introduced in the beginning composed of people, institutions, softwares, clams, mud, and other material participants with whom I have worked as an ethnographer for more than 2 years. The Partners organized around their stated mission to promote ecological and economic resilience within the Bay and my research with them has sought to help advance this mission. I provide two brief examples of how resilience in its current composition constrains their modes of action and how resilience as a dynamic responsiveness based on materiality and an open space of vulnerability might change what they see as possible as they strive for sustainability in the Bay.

At the Frenchman Bay Partners annual retreat in 2013, the facilitator asked us to introduce ourselves and share one or two words about our connection to the Bay. Our words included sustainability, community, livelihoods, recreation, conservation, eel grass, working waterfronts, and the like. After the meeting one of the Partners said to me, "I wanted to say poetry, the Bay gives me poetry. But I didn't because I thought that would be silly." Resilience as currently composed does not have space for poetry in how we respond to each with and within the broader material contexts of our lives. Poetry does not fit the functions of communication as information sharing, memory as storage, and the stable sense of identities that are central to resilience as an SES property.

The second example draws from a group of Partners who are also members of a regional shellfish committee. This group of 80 commercial clam diggers self-organized to steward the intertidal mudflats in seven towns in the Bay. In the monthly meetings that occur in small, rural town hall on the coast, most human participants arrive with traces of mud on their boots and arms. Depending on the tide, they sometimes have

coolers full of clams waiting in their trucks. The clams, mud, and tides matter for the work that gets done in this room. The tides govern when the diggers work, when they can meet, how much they can dig before the tide flows in again. The mud determines where the clams grow which influences the areas on which the diggers focus for their priority conservation activities. The clams themselves respond, most recently to the invasion of green crabs with some diggers hypothesizing that the clams are burrowing deeper into the mud to avoid predation, making the wok of digging them out even harder. All of these materials and more produce capacity for sustainability as defined it by present clam populations, landings data, possible future abundance, and the continuation of clamming as a livelihood and culture.

In both of these examples, discourse draws boundaries around what we see as possible in our responses and collective action. How might the world become different again if poetry was given a space in resilience and the participation of mud, clams, and tides was more fully recognized? Myriad material crises like climate change, ocean acidification, and dramatic shifts in species composition are pushing back on the boundaries we draw. We may need poetry, mud, and tides as much as flexible policy instruments, polycentric governance, and social learning initiatives. Poetry, mud, and tides offer unique standpoints to get us out of the box and beyond merely surviving to fight another day. Working with them to produce sustainability shifts our sense of what it means to be human and where our capacities and differences come from. From this standpoint, we continually come to see that steering takes more than our hand on the wheel. It is a dynamic process of working with the boat, the tides, and maybe even the mud below find our way to new terrain.

At the conclusion of Walker and Salt's *Resilience Thinking*, they describe nine key concepts for resilience thinking, including (in this order): diversity--biological, landscape, social and economic--ecological variability, modularity, acknowledging slow variables, tight feedbacks, social capital, innovation, overlap in governance and ecosystem services (Walker and Salt, 2006). They also invite readers to send them suggestions to add to this list. After working through the discourse, including living it in multiple contexts, I suggest adding this to the list: resilience thinking emphasizes the discursive constitution of what we come to see as possible in our collective striving for sustainability and it recognizes the many emergent modes of response that are possible for knowing and being with the world.

Discourse analysis in environmental communication as a discipline *of* crisis *for* resilience and sustainability helps reveal multiple dissensions in, for example, the contradictions between resilience as sheer persistence for thirty years in a box and resilience as the dynamic and subjective quality of life in that box. Attention to discourse is an opening, an invitation to explore the boxes in which we become trapped. Attention to discourse does not give us answers. Discourse analysis allows us to dwell in the space "that precedes each breath before a moment comes into being and the world is remade again" where we can remember our entanglements and ethical attunements in the world (Barad, 2007, pp. 184-185). Exploring the dimensions of discourse creates openings so that striving to live another day is not a fight nor suffering; it is, instead, a dynamic and sustainable becoming.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

5.1. Introduction

Sustainability science asks us to recognize, understand, and act on the complex interconnections among the planet's systems (Kates et al., 2001). We see this as an invitation to meet complexity not with simplicity but with flexibility, multiplicity, sensitivity to context, and ultimately, strategy. In our discussion and conclusion, we highlight how these three chapters help us think about communication as a discipline *of* sustainability and resilience (Schwarze, 2007). Staying with tension and paradox, we resist the temptation to generalize, produce replicable models, and create best practice lists (Silka, 1999). Instead, following a transdisciplinary strategy we consider questions that our research provokes and how these questions can foster learning and new insights in diverse settings (Jahn et al., 2012; McGreavy et al., 2013). Our questions focus on design, difference, and what it means to work with the world. We ask: What of communication, resilience, and sustainability? What do we do with difference and power? How do we work with the world? These questions and responses overlap but we consider each of them in turn to highlight the kinds of issues they bring into relief.

In this section, we pose and then respond to these three questions that became central in our ongoing provocations to understand the world and make decisions in the face of change and complexity. We then consider the constraints, as opposed to the limitations, in our research in the way that Barad (2007) describes temporary exclusions that are productive but that do not foreclose new becomings. We describe how these constraints have promoted conditions for future research and summarize the projects we

intend to move forward out of this work. I conclude with a brief reflection about the dissertation in the middle of things.

5.2. What Of Communication, Resilience, and Sustainability?

A recent outline circulated within SSI and described possible points of focus for a synthesis paper that would share collective experiences and "truisms" about our successes and failures as an organization. One of the proposed truisms was that process *is* the solution. We think this is an interesting concept and we want to explore it further in light of how we have come to understand sustainability and resilience through our communication research. Two points are worth noting in our initial reaction to this proposal. First, we welcome the insight that process matters, as this recognition was not consistent across our collaborative efforts in the beginning stages of SSI's work. In early stages, we had process and we had outcomes and the relationship among these areas was poorly understood. Through our research in the Knowledge↔Action team, we are making significant progress towards understanding these relationships. The idea that process and solutions are fundamentally integrated, as we emphasize in our SSI and Frenchman Bay research, is an important advance for SSI as an organization. Second, we also agree that solutions are not exclusively material outcomes like a tidal power turbine or new legislation but can be dynamic entanglements as people and materials come together to co-produce the world (Barad, 2007).

However, going beyond these two important points we offer a modification to the idea that process is solution. Solution, for us, seems to imply an end point, a fixed and stable arrival. How do things change if we consider solutions not as end-points and but as endless creative becoming (Barad, 2007)? In this mode, our collaborations are more

about finding ways to live with problems than coming up with "durable" and permanent solutions (Grosz, 2011). While we advocate for process commitments, like access to decision space and a commitment to working the tides, we do not see these as immutable or fixed solutions within sustainability processes. We see them as starting points in the creative dialogue that will allow sustainability as a striving together to produce the kinds of emergent outcomes that we and the world needs. So, we offer a slight reframing to the truism that process is a solution: flip the order and insert some striving. Sustainability is process, a dynamic unfolding that resists solutions as easy closures and instead works for continual novelty to become different again.

5.3. What Do We Do With Difference?

In a presentation we gave at the State of Maine EPSCoR Conference in 2012, we described some of the challenges of interdisciplinary collaboration and we used the term "barrier" to describe differences in language across disciplines. We have since moved away from the idea that difference is a type of barrier and instead more fully seek difference's generative potential. In our research with SSI and in Frenchman Bay, we avoid the language of "overcoming" and "getting past." Instead we try to find productive points of tension to ask questions and spur the emergence of context-dependent and situation-transcendent strategies, like opening up spaces for decision making and working the tides by checking tide charts and creating strategic swirls.

Approaching difference as a driver for creativity points towards another crucial consideration: power. Power as we understand it is relational and creates the conditions for what we come to see as possible (Foucault, 1970). Our discussion of collaborations and partnerships brings issues of power to light in the most direct way; others have also

noted the crucial importance of power within inter- and transdisciplinary collaborations (Gardner, 2012; Macmynowski, 2007). Attention to power in relationships requires us to ask: How do our language practices and the spaces of interaction influence who expresses voice? Whose voices remain silent? How we can change the context in ways that make our shared struggle for power more equitable?

Returning to Clark et al.'s (2011) discussion of boundary work within sustainability, they emphasize attention to power as "essential to good boundary work. Implementing this realization would constitute a major departure from the apolitical, one-directional 'transfer' models that still inform much of the dialogue and practice of science for development" (p. 7). Strategies to enable the inclusion of voice and creativity from difference will likely vary but paying attention to power as it circulates through communication practices is essential. Attention to power also becomes paramount when we consider that sustainability as process will still require decision making to occur and inevitable compromise within complex situations. If collaborators are not sensitive to power and do not try to include diverse voices in the production of compromise, equitable compromise is less likely to occur.

Thus, our commitment to maintain diversity for enhanced collaboration needs to remain sensitive to how power runs through and influences all of our interactions. This is not a one-size-fits-all strategy and there are no easy answers to how this critical reflection would resolve power. However starting with the recognition that it is an inescapable part of collaboration is more likely to promote the ability to realize the potential in difference in ways that are equitable and sustainable.

5.4. How Do We Work With the World?

The mode of working with the world in sustainability as a dynamic unfolding was a central focus on our work in Frenchman Bay and became a jumping off point in resilience discourse analysis. After so many pages of words in this dissertation, it is easy to forget that "what is at work here on the page is an animal—vegetable—mineral—sorority cluster with a particular degree and duration of power" (Bennett, 2010, p. 23). This material cluster is folded into and traces the prolific symbolic production that is this dissertation. However, following a simple line from material to symbol is not possible because, as Bennett (2010) notes, this is a situation where "causality is more emergent than efficient, more fractal than linear. Instead of an effect obedient to a determinant, one finds circuits in which effect and cause alternate position and redound on each other" (Bennett, 2010, p. 33). Working *with* the world in our sustainability science, boundary spanning, and conservation action planning is first acknowledging the locus of our capacities for communication, for writing, planning, and acting come from (Stormer & McGreavy, Under review).

We never do this work alone. Yet, our collaborators are much more diverse than the people sitting at the table with us. Like our attention to power, acknowledging our mutual vulnerabilities is an important starting point in our commitment to keep coming back. From this humble standpoint, we begin to trust how the creative points of emergence, the productive outcomes of swirls, can iteratively open into new terrain.

5.5. Research Complexities and Constraints

The first paragraph of this dissertation introduced the concept of wicked problems, a term that describes these messy and complex situations in which easy

answers elude, actions have multiple and unforeseen consequences, and there are no clear stopping points (Kreuter et al., 2004). Sustainability science is all about wicked problems−this orientation is at the heart of where we focus our efforts to link science and society and promote innovative solutions to many different types of challenges. Sustainability science research focused on wicked problems is similarly complex and operates within constraints which can limit collaborations and research outcomes. Understanding these constraints and how they potentially shape the research is an important process commitment for conducting rigorous engaged sustainability science research. Here I describe primary constraints across and within each of the three projects and how I tried to address these. Some of these constraints are relatively uncomplicated but still important to consider, such as limitations related to time and geography. Other constraints, like those related to power, are more nuanced and required ongoing attention and negotiation. Across all of the projects, cycles of reflective critical inquiry helped call attention to constraints and find ways to work through.

A primary constraint was proximity and I mean this in two ways: as participant observer and, more broadly, as space-time. Adopting a complex adaptive systems view of the world and entering research as a participant observer meant that there was no distance between myself as researcher and those with whom I conducted research (Lincoln & Guba, 1985). My presence and my research had impacts most of which were beyond my control and even my direct perception. I did not try to resolve this constraint. Instead, I paid attention to this dynamic and I reflected on my own and with others to make decisions to the best of our ability given the irreconcilable uncertainty, as I describe in greater detail below.

Further, engaged research on complex problems takes time. In my work in Frenchman Bay, the distance between the University and the Bay shaped the amount of time I could spend in the field. I wanted to be there in-person for every project meeting and special event; in the end that was not possible. Instead, I paid attention to information needs, research priorities, data collection strategies, and made my trips as frequent as possible. Physics became my ultimate research arbiter; holding out hope for significant advances in quantum mechanics, I worked within my current space-time configuration.

Power was an equally complex constraint. I experienced and struggled with power in different ways in each project. In my work in SSI, power influenced what was available to me for empirical study. As one specific example, I initially intended to collaborate with an SES team but I was unable to pursue this type of integrated research due in large part to power dynamics within the organization and in teams. In my work in SSI and more importantly in Frenchman Bay where I was not a member of the community, I tried to maintain an awareness of the myriad ways in which my own participation shaped the collaboration and the contexts within which I conducted this research. I was always aware that my research intervened and I tried to make decisions in light of that awareness. An essential part of my ability to navigate these complex power dynamics was the supportive mentorship I received from my advisors Dr. Laura Lindenfeld and Dr. Linda Silka. Their expertise and guidance helped us collectively find ways to work through complexities related to power in these engaged interdisciplinary research contexts.

5.6. Future Research

In this section, I briefly consider projects I intend to advance from each of the chapters in this dissertation.

5.6.1. Communication and Collaboration

In the second chapter, I described mixed methods research on interdisciplinary collaboration and stakeholder engagement with SSI. One of the key findings from this research is that decision space influenced project outcomes like mutual understanding and progress towards stated goals. We also found that researchers within SSI described growing identities as sustainability scholars and boundary spanners. By bringing resilience as a dynamic responsiveness together with recursivity as self-referential process, we conclude that these dynamics run through an organization to influence emerging patterns of organization for individuals, on teams, and within society. We intend to extend our SSI research in two ways. First, we will conduct a mixed methods study starting in February, 2014 of SSI as an organization in transition. We want to understand current dynamics related to structuration and how these are influencing the organization as it transitions to decentralized funding sources, a signification change in the allocation of resources. Second, we also want to understand structuration, decision making, and communication dynamics across EPSCoR Projects. We will be collaborating with researchers at other institutions to develop a national level study to expand and refine our communication systems framework. We will submit a grant to the Decision, Risk, and Management Science program at the National Science Foundation to advance this work.

We are also taking insights from research with SSI and applying them to the New England Sustainability Consortium (NEST), a collaborative effort between the University of Maine and the University of New Hampshire along with multiple state agencies and non-governmental organizations and funded by the National Science Foundation. Like in SSI, my research with NEST features a large-scale collaboration study drawn from systems theories and resilience literatures using a mix of qualitative and quantitative methods.

5.6.2. Communication and Social-Ecological Systems

As we described in the concluding section of Chapter 3 focused on the Frenchman Bay Partners ethnography, as of November, 2013 the conservation action planning process was ongoing and showing promise of achieving some of its goals. I intend to continue to conduct research with this group. In the next phase of our work, we will collaboratively develop and submit this chapter for publication. There are many more papers that can and will come from the work in Frenchman Bay. For example, I am interested in developing a paper that focuses exclusively on the use of boundary objects in conservation action planning. I am also planning to write a more pragmatic paper that describes communication systems within conservation planning for a conservation biology or marine policy audience.

One of the unexpected points of emergence from my research with the Partners has been my entry into the clam digging community. Starting this doctoral research, I never would have expected that one of my most favorite achievements would be getting a clam digging license. Through this research, I have become fascinated with the ways in which the clam diggers in the seven-town shellfish cooperative are advancing

sustainability in the Bay. I intend to continue to support their work and advise the 610 Project. I am also in the beginning stages of a book project that will extend my work with the clam diggers and my discussion of materiality and sustainability in mud and the tides.

5.6.3. Resilience Discourse: Bio-Power and Panarchy

At one point in the long and meandering process that was the resilience discourse analysis, I started to get side-tracked by the bio-politics of resilience. This in part came from an experience at the Conference on Communication and the Environment that centered around how resilience as a discourse has become a way to control and govern subjects through power (Foucault, 1980). Fortunately I got pulled out of the weeds as I veered off the archaeology into bio-power. But from this side trip, I realized that a genealogy would be an important and fruitful next step to consider how constructions of resilience are being taken up in governing and grant-making institutions. I want to know how resilience as persistence and coping influences what projects that get funded, what the requirements are for demonstrating improved resilience, and how people who receive funds or work within organizations that focus on resilience experience its power. I see this project as one that would require a mixed qualitative and archival case study.

In the discourse analysis, I focused primarily on the basins of attraction visual model. As a next step, I am interested in exploring the adaptive cycle, also known as the panarchic cycle, which describes phases of transformation as growth, conservation, release, and reorganization in an infinity loop arrangement. This model has been used to explain ecological and social change in a variety of contexts with varying degrees of consistency (Gotts, 2007; Gunderson & Holling, 2001; Miller et al., 2008). I would like

to put the panarchic cycle in conversation with Burke's dramatism and cycles of guilt and redemption (Burke, 1969a). I think there could be some useful elaboration of the dynamics of social change and would be another opening for social theory to enhance SES literatures.

5.7. In the Middle of Things: A Concluding Reflection

In one of the first presentations I gave in the field of communication, I shared previous research I conducted on vernal pools for my master's thesis (McGreavy, Webler, & Calhoun, 2012). In this presentation I described myself as someone who followed salamanders on Big Night to the edge of vernal pools. As I stood on the edge of these pools in the woods on these warm rainy nights, I was taken in by the complexity, the interactions among water, algae, egg masses, sunlight, trees, and more. The more time I spent with vernal pools, the more I came to care about these systems. Through that opening, human beings entered my field of view of what a pool was and how and why they change. As I wrapped up my thesis on the human dimensions of vernal pool conservation, I thought I was at an end point. However, the questions that emerged in the course of this research led me to communication and sustainability science.

In my entry into communication, I took up vernal pool as a boundary object, though I would not have described it in this way at the time. I described coming to the edge of the field of communication and being pulled in by the diversity of theories and methods circulating in this new terrain. My field of view was narrow, and it still is. I wanted to know more, and still do. As the list of projects I hope to advance shows, much remains to be done. In this work, I am no longer in search of end points and easy conclusions. Instead, I look for openings for becoming again and again.

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APPENDICES

APPENDIX A:
IRB APPROVAL: SSI COLLABORATION

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board
114 Alumni Hall, 581-1498

PRINCIPAL INVESTIGATOR: Bridie McGreavy, Communication and Journalism
EMAIL: bridie.mcgreavy@maine.edu **TELEPHONE:** (207) 595-2240
CO-INVESTIGATOR(S): Laura Lindenfeld, Associate Professor, Communication and Journalism; Linda Silka, Margaret Chase Smith Policy Center; Michael Quartuch, Forest Resources; Damon Hall, Postdoctoral Fellow, Sustainability Solutions Initiative; Karen Hutchins, Communication and Journalism; Hollie Smith Communication and Journalism; Colleen Budzinski, Communication and Journalism
FACULTY SPONSOR (Required if PI is a student): Laura Lindenfeld and Linda Silka
TITLE OF PROJECT: Knowledge to Action Frameworks in an Interdisciplinary Collaborative Sustainability Science Research Project

START DATE: October 2010 **PI DEPARTMENT:** Communication and Journalism
MAILING ADDRESS: 429 Dunn Hall
FUNDING AGENCY (if any): Supported by the National Science Foundation award, EPS-0904155 to Maine EPSCoR at the University of Maine
STATUS OF PI: PhD student
FACULTY/STAFF/GRADUATE/UNDERGRADUATE Graduate

1. **If PI is a student, is this research to be performed:**

   ☐ **for an honors thesis/senior thesis/capstone?** ☐ **for a master's thesis?**
   X **for a doctoral dissertation?** ☐ **for a course project?**
   ☐ **other (specify)**

2. **Does this application modify a previously approved project? N (Y/N). If yes, please give assigned number (if known) of previously approved project:**

3. **Is an expedited review requested? Y (Y/N).**

SIGNATURES: All procedures performed under the project will be conducted by individuals qualified and legally entitled to do so. No deviation from the approved protocol will be undertaken without prior approval of the IRB.

Faculty Sponsors are responsible for oversight of research conducted by their students. By signing this application page, the Faculty Sponsor ensures that the conduct of such research will be in accordance with the University of Maine's *Policies and Procedures for the Protection of Human Subjects of Research*.

10/18/10 electronic Per email
Date **Principal Investigator** **Faculty Sponsor**

Co-Investigator **Co-Investigator**

****

FOR IRB USE ONLY **Application #** 2010-10-17 **Date received** 10/18/10 **Review (F/E):** E
Expedited Category: _____

ACTION TAKEN:

X **Judged Exempt; category** 2 **. Modifications required?** Y **(Y/N) Accepted (date)** 10/29/10
_____ **Approved as submitted. Date of next review: by** _____ **. Degree of Risk:** _____
_____ **Approved pending modifications. Date of next review: by** _____ **. Degree of Risk:** _____
Modifications accepted (date): _____ **.**
_____ **Not approved. (See attached statement.)**
_____ **Judged not research with human subjects**

Date: 10/23/10 **Chair's Signature:** Cynthia A. Eadley 10/09

APPENDIX B:

INTERVIEW PROTOCOL FOR SSI COLLABORATION

Thank you for taking the time to meet with me/us today. The Knowledge-Action team is trying to understand how other people on SSI think about and approach knowledge and action in research. Our team is working to describe concepts of and practices related to knowledge and action across the SSI to inform a workshop in the spring. We greatly appreciate your willingness to contribute your thoughts to this research.

Warm-up Questions: Team Dynamics

1. How many teams are you involved with? Can you give me a brief summary of each one?

2. So, how does your team makes decisions? Who makes them? Can you explain that process for me?

Engagement Questions

3. If you had to explain your project to a non-scientist (someone unfamiliar) with it, what would you say?

4. Thinking about your SSI project, who are your key stakeholders? What are their interests in this project? Do you see any challenges working with them? How about advantages?

5. Have you engaged with stakeholders? Describe how you engage with them. Do you have a reason for working with them in this way? *Question 5 may not be necessary based on the depth of response in #4.*

6. How do you imagine that the research on your team will matter to these stakeholders?

Knowledge and Action Questions

7. There have been various ways of labeling this work, including Knowledge Action Systems, Knowledge To Action, Knowledge With Action, Knowledge From Action, Knowledge And Action, Knowledge co-production. *Show list on following page.* What phrase do you use or prefer and why? *Note: This may emerge earlier in the conversation: Read your respondent's reactions at your first mention of this term, wait for the moment and then use this formal question.*

8. In your view, what does linking knowledge and action have to do with "sustainability science"?

9. How has the emphasis on knowledge and action *(or use their preferred term)* changed the way you view your research? How is this different from the way others on SSI use this term?

Concluding Questions
Say: "I have three more questions."

The Knowledge-Action team is thinking about conducting a workshop in the coming months.

10. How do we include what is most important to you as part of this workshop? What do you need? What do you want to explore?

11. Based on everything we have talked about, what is most important to you about linking knowledge and action *use their term*?

12. Is there anything else I should know and did not think to ask?

**Italics are notes for the interviewer.*

APPENDIX C:

SURVEY PROTOCOL FOR SSI COLLABORATION

Thank you for helping us conduct research and for contributing to our dissertations through your responses. As described in the upcoming Informed Consent form, your responses will help strengthen the available research on stakeholder engagement in science and contribute to future SSI workshops on stakeholder engagement. If you prefer to provide your insights over the phone, by e-mail, or in-person, please contact the lead researchers: Karen Hutchins and Bridie McGreavy. Karen can be reached by e-mail at karen.hutchins@umit.maine.edu. Bridie can be reached by e-mail at bridie.mcgreavy@maine.edu. Thank you again for completing this survey. Bridie and Karen

INFORMED CONSENT

You have been asked to participate in a research study being conducted by researchers at the University of Maine Orono who are affiliated with the Sustainability Solutions Initiative umaine.edu/sustainability solutions). The purpose of the research is to study researcher motivation for and collaboration with stakeholders. The focus of the research survey will be on team interactions, communication, motivation, and university-community collaborations in various small groups dealing with sustainability issues. In addition to contributing to research on stakeholder engagement in science, the findings will inform the development of SSI workshops on knowledge-action, hopefully assisting all teams. This study is being conducted by personnel from the University of Maine in Orono, including Karen Hutchins and Bridie McGreavy, doctoral students in the Department of Communication and Journalism, and Drs. Laura Lindenfeld and Linda Silka from the Margaret Chase Smith Policy Center.

What will you be asked to do? If you decide to participate, you will be asked to participate in an online survey. The survey will take approximately 15 minutes to complete. You will be asked to respond to statements that address such issues as your style preferences for stakeholder-university/college partnerships and experiences with and trust in a specific stakeholder.

Risks Except for your time and inconvenience, there are no foreseeable risks to you in participating in this study.

Benefits. Your participation is important to the success of the study and will contribute to the research being conducted by Maine's Sustainability Solutions Initiative. The project will benefit present and future community-university partnerships by helping us understand successful and inhibiting communication and collaboration variables between diverse groups working together to solve complex issues. The research may benefit you personally as it will inform future workshops that we hope will assist teams with their stakeholder engagement efforts.

Confidentiality. The information you provide will be treated as professional confidences. No information, which might directly identify you, will be presented in any

possible research reports or communications. Your name will not be associated with your responses to the survey. Data generated through the survey software will remove identifying markers such as e-mail and name before the survey results are generated. Written reports summarizing the findings of the research project will present only general results. The survey data will be kept in perpetuity.

Voluntary. Participation is voluntary. If you choose to take part in the study, you may stop at any time or skip any items in the survey. Completion of the online survey implies consent to participate. You can refuse to take the survey and still be part of the group recordings and/or interviews.

Contact information. If you have any questions, comments, or concerns about the study, please contact Karen or Bridie via: phone: (207) 581-3859; mail: 5784 York Village, Building #4, Margaret Chase Smith Policy Center, University of Maine, Orono, ME 04469, or e-mail: karen.hutchins@umit.maine.edu or bridie.mcgreavy@maine.edu. You may also reach our faculty advisor via: phone (207) 581-3850; mail: 5784 York Village, Building #4, Margaret Chase Smith Policy Center, University of Maine, Orono, ME 04469, or e-mail: laura.lindenfeld@umit.maine.edu. If you have any questions about your rights as a research participant, please call or write: Gayle Jones, Assistant to the University of Maine's Protection of Human Subjects Review Board, at: (207) 581-1498 or gayle.jones@umit.maine.edu.

1 Please select the SSI teams(s) to which you belong. The common abbreviation for this team is provided and the full team name is in parentheses.

- ❑ Alternative Futures (Analysis of Alternative Futures in the Maine Landscape using Spatial Models of Coupled Social and Ecological Systems) (1)
- ❑ Alternative Futures- Combined Project (Application of an Integrative Decision Support Tool and Spatial Modeling to Assess the Implications of Future Growth Scenarios on Sensitive Aquatic Resources in Maine) (2)
- ❑ Belgrade Lakes - Colby (Modeling Resilience and Adaptation in the Belgrade Lakes Watershed) (3)
- ❑ Biofuels - UMPI (Modeling Evolving Ecological, Cultural, and Economic Systems of the Aroostook River Watershed of Northern Maine for Sustainable Development) (4)
- ❑ Biomass Energy - UMFK (Biomass Energy Resources in the St. John Valley, Aroostook County, Maine: Development Potential, Landscape Implications, and Replication Possibilities) (5)
- ❑ Coastal Adaptation (Adaptation Strategies in a Changing Climate: Maine's Coastal Communities and the Statewide Stakeholder Process) (6)
- ❑ Cyber-informatics (An SSI Cyber-Informatics Development Plan) (7)
- ❑ EAB (Mobilizing Diverse Interests to Address Invasive Species Threats to Coupled Natural/Human Systems: The Case of the Emerald Ash Borer in Maine) (8)
- ❑ ECCO (Effects of Climate Change on Organisms) (9)
- ❑ ESCAPE (Ecological and Social Change: Adaptation, Place, and Evaluation) (10)
- ❑ K-A Collaborative (The Knowledge-Action Collaborative) (11)
- ❑ Lessons from a Diverse Portfolio (Lessons from a Diverse Portfolio: Building Applicable Knowledge through a Multi-Method Framework for Coupled-Systems Research) (12)
- ❑ OI (Systems Analysis of SSI: Navigating Perspectives, Paradigms, and Problemscapes) (13)
- ❑ Rangeley Lakes - UMF (Promoting Watershed-Based Sustainable Development through Ecological and Socio-Economic Research and Educational Initiatives) (14)
- ❑ Restoring Maine's Rivers - Bates, Bowdoin, USM (Ecological and Economic Recovery and Sustainability of the Kennebec and Androscoggin Rivers and their Common Estuary and Nearshore Marine Environment) (15)
- ❑ Saco - UNE (Sustaining Quality of Place in the Saco River Estuary through Community Based Ecosystem Management) (16)
- ❑ Sebago (Decision Tools to Support Water Resources Sustainability of Managed Lake Systems) (17)
- ❑ SES Synergy (SES synergy: Finding and Applying Best Practices in Socio-ecological Systems Modeling and Outreach) (18)
- ❑ Socio-Economic Data (Building Capacity and Coherence: Integration of Socio-Economic Data Collection) (19)
- ❑ SURP (Sustainable Urban Regions Project) (20)
- ❑ Tidal Energy (Maine Tidal Power Initiative: Linking Knowledge to Action for Responsible Development of Tidal Power) (21)

- ❑ Turkeys and Agriculture - UMA (Evaluating the Effects of Turkeys on Maine Agriculture) (22)
- ❑ Vernal Pools (Protecting Natural Resources at the Community Scale: Using Population Persistence of Vernal Pool Fauna as a Model System to Study Urbanization, Climate Change and Forest Management) (23)
- ❑ Woolly Adelgid - Unity (Understanding the Relationships Among Biodiversity, Forest Management, and Invasive Species Disturbance in a Forested New England Landscape) (24)
- ❑ Other team (Write in team name): (25) _____

Section One.
Stakeholder-University Partnerships

In this section, we would like to learn about the stakeholders with whom you are working, and your opinions about stakeholder-university partnerships. By partnerships, we mean the ways that university and college researchers and stakeholders work together to address community, state, or global issues. In order to keep this survey to 15 minutes, please answer the questions in this survey for your primary SSI research team. If you have more than one primary team, choose one team as the basis for your answers. At the end of the survey, you will have the option of choosing to answer multiple surveys for multiple teams if you are interested in doing so.

2 What do you consider your primary SSI research team for the purpose of answering this survey?

3. Overall, how much do you disagree or agree with the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Disagree nor Agree (3)	Agree (4)	Strongly Agree (5)
My team members communicate well with each other. (1)	❍	❍	❍	❍	❍
I feel like I understand the goals of fellow team members. (2)	❍	❍	❍	❍	❍
My team rarely shows respect for diverse opinions. (3)	❍	❍	❍	❍	❍
My team laughs or uses humor frequently. (4)	❍	❍	❍	❍	❍
I am very involved in the decision making on my team. (5)	❍	❍	❍	❍	❍
I would like to be more involved in the decision making on my team. (6)	❍	❍	❍	❍	❍
My team rarely discusses outcomes. (7)	❍	❍	❍	❍	❍
My ideas are frequently incorporated into the project and team decisions. (8)	❍	❍	❍	❍	❍

My team actively works to build a common language. (9)	❍	❍	❍	❍	❍
My team often disagrees on important project issues. (10)	❍	❍	❍	❍	❍

4. The following is a list of stakeholder groups SSI researchers identified during the Knowledge-Action interviews with a sample of SSI researchers. Please select the level at which each group is involved in your primary SSI research team. Please answer for each stakeholder group:

	Not Involved (1)	Somewhat Involved (2)	Involved (3)	Very Involved (4)	Don't know (5)
Cooperative Extension (1)	❍	❍	❍	❍	❍
Departmental colleagues (not on SSI) (2)	❍	❍	❍	❍	❍
Federal agencies/officials (3)	❍	❍	❍	❍	❍
Fellow researchers on SSI teams (4)	❍	❍	❍	❍	❍
Future generations (5)	❍	❍	❍	❍	❍
Individual citizens (6)	❍	❍	❍	❍	❍
K-12 schools (7)	❍	❍	❍	❍	❍
More-than-human world (8)	❍	❍	❍	❍	❍
Municipal officials (9)	❍	❍	❍	❍	❍
Myself (10)	❍	❍	❍	❍	❍
National Science Foundation (NSF) (11)	❍	❍	❍	❍	❍
Non-profit organization/NGOs (12)	❍	❍	❍	❍	❍
Private sector (13)	❍	❍	❍	❍	❍
State agencies/officials (State, federal) (14)	❍	❍	❍	❍	❍
SSI (15)	❍	❍	❍	❍	❍
Tribal communities (16)	❍	❍	❍	❍	❍
University or college administrators (17)	❍	❍	❍	❍	❍
Other (18)	❍	❍	❍	❍	❍

5. Please select how much do you disagree or agree with the following statements: "I was motivated to engage stakeholders in my SSI project(s) because . . ."

	Strongly Disagree (1)	Disagree (2)	Neither Disagree nor Agree (3)	Agree (4)	Strongly Agree (5)
they will help me be the kind of scholar I want to be. (1)	❍	❍	❍	❍	❍
of the funding SSI provides. (2)	❍	❍	❍	❍	❍
SSI requires me to include them. (3)	❍	❍	❍	❍	❍
I really enjoy working with stakeholders. (4)	❍	❍	❍	❍	❍
I don't have the right to exclude stakeholders from processes that may impact them. (5)	❍	❍	❍	❍	❍
I feel like I've failed if my research isn't used by society. (6)	❍	❍	❍	❍	❍
it will help me educate and train citizens, a central goal in my work. (7)	❍	❍	❍	❍	❍
it makes my research relevant and locally appropriate. (8)	❍	❍	❍	❍	❍

	Strongly Disagree (1)	Disagree (2)	Neither Disagree nor Agree (3)	Agree (4)	Strongly Agree (5)
my colleagues brought them into the process. (9)	❍	❍	❍	❍	❍
of the satisfaction I experience from taking on interesting challenges. (10)	❍	❍	❍	❍	❍
I want to help empower stakeholders to have a voice in the research. (11)	❍	❍	❍	❍	❍
I want to be recognized by my peers as doing this work well. (12)	❍	❍	❍	❍	❍
the partnership(s) ensure stakeholders' and researchers' needs are met. (13)	❍	❍	❍	❍	❍
it helps me bring on more graduate students. (14)	❍	❍	❍	❍	❍
my department required my participation. (15)	❍	❍	❍	❍	❍
I enjoy learning from people with different types of knowledge. (16)	❍	❍	❍	❍	❍
I believe the issue I study is in a state of crisis. (17)	❍	❍	❍	❍	❍
it will help ensure the sustainability of the issue(s)/resource I study/care about. (18)	❍	❍	❍	❍	❍
I have nothing to lose. (19)	❍	❍	❍	❍	❍
their involvement in this research is more likely to influence individual and/or institutional action. (20)	❍	❍	❍	❍	❍
it will help resolve conflict among stakeholders. (21)	❍	❍	❍	❍	❍

6. How dissatisfied or satisfied are you with your SSI team's stakeholder engagement?

❍ Very Dissatisfied (1)
❍ Dissatisfied (2)
❍ Neutral (3)
❍ Satisfied (4)
❍ Very Satisfied (5)

7. How much do you disagree or agree with the following statements:

	Strongly Disagree (1)	Disagree (2)	Neither Disagree nor Agree (3)	Agree (4)	Strongly Agree (5)
I have a natural talent for stakeholder work. (1)	❍	❍	❍	❍	❍
I do not feel that I have the skills to engage stakeholders in my research. (2)	❍	❍	❍	❍	❍
I feel like I am getting better at stakeholder engagement. (3)	❍	❍	❍	❍	❍

8. How unlikely or likely is it that you'll continue engaging stakeholders in your research after Year Five of SSI?

❍ Very Unlikely (1)
❍ Unlikely (2)
❍ Undecided (3)
❍ Likely (4)
❍ Very Likely (5)

9. Please describe why you think that you will or will not engage stakeholders in your research after Year Five of SSI.

10. We are trying to understand the different phases in which researchers involve stakeholders in their research. From the menu of options, please select the stage(s) in which stakeholders have been or will be involved in your SSI research. Please select all stages of involvement that apply for each stakeholder type involved in your SSI work on this team (Part I)

	Identifying problem(s) (1)	Developing research questions (2)	Developing study methods (3)	Providing data to researchers (4)	Collecting data (5)
Cooperative Extension (1)	❑	❑	❑	❑	❑
Departmental colleagues (not on SSI) (2)	❑	❑	❑	❑	❑
Federal agencies/officials (3)	❑	❑	❑	❑	❑
Fellow researchers on SSI teams (4)	❑	❑	❑	❑	❑
Future generations (5)	❑	❑	❑	❑	❑
Individual citizens (6)	❑	❑	❑	❑	❑
K-12 schools (7)	❑	❑	❑	❑	❑
More-than-human world (8)	❑	❑	❑	❑	❑
Municipal officials (9)	❑	❑	❑	❑	❑
Myself (10)	❑	❑	❑	❑	❑
National Science Foundation (NSF) (11)	❑	❑	❑	❑	❑
Non-profit organization/NGOs (12)	❑	❑	❑	❑	❑
Private sector (13)	❑	❑	❑	❑	❑
State agencies (14)	❑	❑	❑	❑	❑
SSI (15)	❑	❑	❑	❑	❑
Tribal communities (16)	❑	❑	❑	❑	❑
University or college administrators (17)	❑	❑	❑	❑	❑
Other (18)	❑	❑	❑	❑	❑

10. We are trying to understand the different phases in which researchers involve stakeholders in their research. From the menu of options, please select the stage(s) in which stakeholders have been or will be involved in your SSI research. Please select all stages of involvement that apply for each stakeholder type involved in your SSI work on this team (Part II, continued from above).

	Developing solutions (6)	Disseminating findings (7)	Using data and/or models provided by researchers (8)	Implementing solutions (9)	Assessing outcomes (10)	Don't know (11)
Cooperative Extension (1)	❑	❑	❑	❑	❑	❑
Departmental colleagues (not on SSI) (2)	❑	❑	❑	❑	❑	❑
Federal agencies/officials (3)	❑	❑	❑	❑	❑	❑
Fellow researchers on SSI teams (4)	❑	❑	❑	❑	❑	❑
Future generations (5)	❑	❑	❑	❑	❑	❑
Individual citizens (6)	❑	❑	❑	❑	❑	❑
K-12 schools (7)	❑	❑	❑	❑	❑	❑
More-than-human world (8)	❑	❑	❑	❑	❑	❑
Municipal officials (9)	❑	❑	❑	❑	❑	❑
Myself (10)	❑	❑	❑	❑	❑	❑
National Science Foundation (NSF) (11)	❑	❑	❑	❑	❑	❑
Non-profit organization/NGOs (12)	❑	❑	❑	❑	❑	❑
Private sector (13)	❑	❑	❑	❑	❑	❑
State agencies (14)	❑	❑	❑	❑	❑	❑
SSI (15)	❑	❑	❑	❑	❑	❑
Tribal communities (16)	❑	❑	❑	❑	❑	❑
University or college administrators (17)	❑	❑	❑	❑	❑	❑
Other (18)	❑	❑	❑	❑	❑	❑

Stakeholder-university/college partnerships can be structured in many ways. By partnerships, we mean ways university/college researchers and stakeholders work together to address community, state, or global problems. We are interested in your opinion about four strategies for stakeholder-university/college partnerships. The strategies differ according to how stakeholders and university/college researchers share responsibilities.

Type of partnership	Problem Identification	Research	Proposed Solutions	Implementation
A. University as **Lead** Partner	Univ. researchers	Univ. researchers	Univ. researchers	Municipal officials
B. University as **Consulting** Partner	Municipal officials Univ. researchers	Univ. researchers	Univ. researchers	Municipal officials
C. University as **Facilitating** Partner	Municipal officials Univ. researchers	Univ. researchers	Municipal officials Univ. researchers	Municipal officials
D. University as **Full** Partner	Municipal officials Univ. researchers	Municipal officials Univ. researchers	Municipal officials Univ. researchers	Municipal officials Univ. researchers

11. Please select your preference for the four strategies for stakeholder-university/college partnerships described above. Please answer for each strategy.

	Not Preferred (1)	Somewhat Preferred (2)	Preferred (3)	Highly Preferred (4)
Lead Partner (1)	❍	❍	❍	❍
Consulting Partner (2)	❍	❍	❍	❍
Facilitating Partner (3)	❍	❍	❍	❍
Full Partner (4)	❍	❍	❍	❍

Section Two. Stakeholder Collaboration Experiences.

In this section, we would like to learn about your experiences with your current SSI stakeholder collaboration(s) on your primary SSI team.

12. Over the past year, about how often have you communicated with your stakeholder(s)?

	Daily (1)	Weekly (2)	Bi-Weekly (3)	Monthly (4)	Quarterly (5)	Annually (6)	Never (7)	Don't know (8)
Cooperative Extension (1)	❍	❍	❍	❍	❍	❍	❍	❍
Departmental colleagues (not on SSI) (2)	❍	❍	❍	❍	❍	❍	❍	❍
Federal agencies/officials (3)	❍	❍	❍	❍	❍	❍	❍	❍
Fellow researchers on SSI teams (4)	❍	❍	❍	❍	❍	❍	❍	❍
Future generations (5)	❍	❍	❍	❍	❍	❍	❍	❍
Individual citizens (6)	❍	❍	❍	❍	❍	❍	❍	❍
K-12 schools (7)	❍	❍	❍	❍	❍	❍	❍	❍
More-than-human world (8)	❍	❍	❍	❍	❍	❍	❍	❍
Municipal officials (9)	❍	❍	❍	❍	❍	❍	❍	❍
Myself (10)	❍	❍	❍	❍	❍	❍	❍	❍
National Science Foundation (NSF) (11)	❍	❍	❍	❍	❍	❍	❍	❍
Non-profit organization/NGOs (12)	❍	❍	❍	❍	❍	❍	❍	❍
Private sector (13)	❍	❍	❍	❍	❍	❍	❍	❍
State agencies (14)	❍	❍	❍	❍	❍	❍	❍	❍
SSI (15)	❍	❍	❍	❍	❍	❍	❍	❍
Tribal communities (16)	❍	❍	❍	❍	❍	❍	❍	❍
University or college administrators (17)	❍	❍	❍	❍	❍	❍	❍	❍
Other (18)	❍	❍	❍	❍	❍	❍	❍	❍

13. Please select the top two communication channels you use most frequently when communicating with your stakeholders? Enter "1" for the most frequently used channel and "2" for the second most frequently used channel.

	Face to face meetings (1)	Video, phone and/or conference call (2)	Technical reports and/or newsletters (3)	E-mail (4)	Blogs (5)	Project or Research Website (6)	Don't know (7)
Cooperative Extension (1)							
Departmental colleagues (not on SSI) (2)							
Federal agencies/officials (3)							
Fellow researchers on SSI teams (4)							
Future generations (5)							
Individual citizens (6)							
K-12 schools (7)							
More-than-human world (8)							
Municipal officials (9)							
Myself (10)							
National Science Foundation (NSF) (11)							
Non-profit organization/NGOs (12)							
Private sector (13)							
State agencies (14)							
SSI (15)							
Tribal communities (16)							
University or college administrators (17)							
Other (18)							

14. If there is another way you communicate with your stakeholders that is not listed as an option, please describe here:

15. About how many months or years have you worked with the following stakeholder(s)?

	Less than 3 months (1)	3 months to 1 year (2)	1 to 3 years (3)	3 to 5 years (4)	5 to 10 years (5)	10+ years (6)	Don't know (7)
Cooperative Extension (1)	❍	❍	❍	❍	❍	❍	❍
Departmental colleagues (not on SSI) (2)	❍	❍	❍	❍	❍	❍	❍
Federal agencies/officials (3)	❍	❍	❍	❍	❍	❍	❍
Fellow researchers on SSI teams (4)	❍	❍	❍	❍	❍	❍	❍
Future generations (5)	❍	❍	❍	❍	❍	❍	❍
Individual citizens (6)	❍	❍	❍	❍	❍	❍	❍
K-12 schools (7)	❍	❍	❍	❍	❍	❍	❍
More-than-human world (8)	❍	❍	❍	❍	❍	❍	❍
Municipal officials (9)	❍	❍	❍	❍	❍	❍	❍
Myself (10)	❍	❍	❍	❍	❍	❍	❍
National Science Foundation (NSF) (11)	❍	❍	❍	❍	❍	❍	❍
Non-profit organization/NGOs (12)	❍	❍	❍	❍	❍	❍	❍
Private sector (13)	❍	❍	❍	❍	❍	❍	❍
State agencies (14)	❍	❍	❍	❍	❍	❍	❍
SSI (15)	❍	❍	❍	❍	❍	❍	❍
Tribal communities (16)	❍	❍	❍	❍	❍	❍	❍
University or college administrators (17)	❍	❍	❍	❍	❍	❍	❍
Other (18)	❍	❍	❍	❍	❍	❍	❍

Your feedback will help inform the development of stakeholder-university partnerships. Please enter any additional comments that you feel will help us identify opportunities for and barriers to developing stakeholder-university partnerships, such as conditions that would need to be met for partnership success.

16. Please enter any additional comments you would like to share to help us understand your work with stakeholders.

Section Three. Background Information

In this section, we would like to learn demographic information.

17. Please select your institutional affiliation:

- ❍ Partner Institution: Bates, Bowdoin, Colby, University of New England, Unity (1)
- ❍ University of Maine, Orono; University of Southern Maine (2)
- ❍ University of Maine System: UMA, UMF, UMFK, UMPI (3)

18. Please indicate your primary institutional affiliation(s):

- ❑ Administrative (1)
- ❑ Biophysical sciences (2)
- ❑ Engineering (3)
- ❑ Fine Arts or Humanities (4)
- ❑ Social sciences (5)
- ❑ Other (6) _____

19. Please select your position(s) within your institution:

- ❑ Director or other upper administrative position (1)
- ❑ Faculty (2)
- ❑ Graduate Student (3)
- ❑ Post-Doctoral Fellow (4)
- ❑ Professional staff (5)
- ❑ Other (6) _____

20. Please select the type of faculty position:

- ❑ Adjunct Faculty (1)
- ❑ Research Faculty (2)
- ❑ Lecturer (3)
- ❑ Tenure track (4)
- ❑ Other (5) _____

21. Please select your professorship level:

- ❍ Assistant Professor (1)
- ❍ Associate Professor (2)
- ❍ Full Professor (3)

22. Please select your tenure status.

- ❍ Pretenure (1)
- ❍ Tenured (2)

23. How long have you been a member of SSI?

- ❍ 0 to 6 months (1)
- ❍ 6 months to 1 year (2)
- ❍ 1 to 2 years (3)
- ❍ 2 to 3 years (4)
- ❍ 3+ years (5)

24. If you feel that the answers you provided for your primary team are inconsistent with how you would respond for another team, please feel free to complete the survey for another one of your teams. Would you like to complete another survey?

- ❍ Yes (1)
- ❍ No (2)

25. For how many additional teams would you like to complete this survey? Please enter a number (no more than 5).

APPENDIX D:

INTERVIEW PROTOCOL FOR SSI MEMBER CHECKING

Thank you for taking the time to meet with me/us today. The Knowledge↔Action team is trying to verify our interpretations from a two-year mixed methods study of interdisciplinary collaboration, stakeholder engagement, and learning in SSI. We greatly appreciate your willingness to contribute your thoughts to this research.

I. Warm Up Question

1. What is your team currently working on? How is your SSI project going?

II. Confirmatory Questions

As you know, the K↔A collaborative has been conducting a two-year mixed methods study of the many aspects of communication and collaboration within SSI. We would like to get your perspective on some of our main conclusions from this work. I am going to read a statement and then ask you to share your thoughts about how this statement compares with your experience on SSI.

The first set of questions focus on conclusions we intend to make about team dynamics like decision making and the ways in which we communicate with each other.

Team Dynamics:

Statement One: We identified the five primary decision making models including problem-project specific, core team, consensus based, single person decision maker, and no decision making structure. We also noted two themes of student and stakeholder roles in decision making.

2. Which of these best describes the decision making on your team(s)?

3. How would you characterize student and stakeholder roles in decision making?

Statement Two: Most teams on SSI seem to be using a consensus based or problem project specific model of decision making. These are decision making models where people have a space to talk about their own perspectives and find ways to work through differences.

4. How does this interpretation fit your own experience on your team? Across SSI?

Statement Three: Decision making approaches in interdisciplinary collaboration and stakeholder engagement affect how individuals feel about the process, their ongoing commitment to continuing to work together, and the eventual project outcomes such as the implementation of plans, development of new technologies, and drafting legislation.

5. Do you agree that decision making is important and affects outcomes? Why or why not?

Statement Four: It appears that teams using a single-person decision making model are not having as much success as those team that use more participatory approaches, when success is measured by individual satisfaction and progress towards stated goals.

6. Have you experienced or observed this decision making model on SSI, and if so, does this interpretation match your observations?

Statement Five: Team members reported a high degree of communication competence, meaning team members demonstrate respect, trust, engaged listening and they do not largely use sarcasm, jockey for power, or demonstrate boredom among other features. Team members also said that humor is important in their communication.

7. To what degree does this correspond with your team-based communication? Are there other facets of your communication that influence how you work together?

Statement Six: Interdisciplinary collaboration is challenging and we are still finding ways of working through these challenges within our teams and within the organization as a whole.

8. Has this been your experience? Please explain your sense of interdisciplinary collaboration on your team and in SSI.

Now I am going to ask you to respond to a few statements about our conclusions on stakeholder engagement.

Stakeholder Engagement

Statement Seven: In the survey and interviews, we found that members of SSI seem motivated to work across disciplines and with stakeholders because they see themselves as sustainability scientists, want to span different kinds of boundaries, and because the NSF funding facilitated their ability to do this work.

9. To what degree does this correspond with and/or differ from your sense of your own motivations?

10. Do you plan to continue to engage stakeholders in your research? If so, why? If not, why not?

The final set of conclusions focus on a concept called resilience. We broadly understand resilience as a way to think about how we as individuals, teams, and as an organization as a whole respond to and learn from each other, find ways to adapt when we need to, and persist under changing circumstances.

Learning and Resilience
The K↔A Collaborative has coordinated multiple formal and informal learning events. In which of the following events have you participated? [show list]

- K↔A Workshop on December 6th, 2012
- SSI Annual Retreat, Facilitated World Café Discussion Session, May 16th, 2012
- Science Communication Training for MPBN Documentary Series, ongoing
- Maine Policy Review Special Issue, March, 2012

I am interested in learning more about your experiences related to these events.

11. Did any of these events change how your interdisciplinary collaboration?

12. Did any of these events affect your stakeholder engagement?

13. Did you make any new connections through these events and have you followed up on these connections?

14. What do you still want to learn about in terms of linking knowledge and action?

III. Concluding Questions

15. Is there anything else I should know and did not think to ask?

APPENDIX E:

IRB APPROVAL: FRENCHMAN BAY PARTNERS

APPLICATION FOR APPROVAL OF RESEARCH WITH HUMAN SUBJECTS
Protection of Human Subjects Review Board
114 Alumni Hall, 581-1498

PRINCIPAL INVESTIGATOR: Bridie McGreavy, Communication and Journalism,
Nikita Kacer, International business major
EMAIL: bridie.mcgreavy@maine.edu **TELEPHONE:** (207) 595-2240
Nikita.kacer@umit.maine.edu
CO-INVESTIGATOR(S): Laura Lindenfeld, Associate Professor, Communication and Journalism; Linda Silka, Margaret Chase Smith Policy Center; Damon Hall, Postdoctoral Fellow, Sustainability Solutions Initiative; Karen Hutchins, Communication and Journalism; Colleen Budzinski, Communication and Journalism, Amy Becker, Communication and Journalism, Lauren Thornbrough, Communication and Journalism; Taylor Chasse, Incoming freshman, Pre-nursing
FACULTY SPONSOR (Required if PI is a student): Laura Lindenfeld and Linda Silka
TITLE OF PROJECT: Stakeholder Perspectives in the Frenchman Bay Planning Process

START DATE: July 2011 **PI DEPARTMENT:** Communication and Journalism
MAILING ADDRESS: 429 Dunn Hall
FUNDING AGENCY (if any): Supported by the National Science Foundation award, EPS-0904155 to Maine EPSCoR at the University of Maine
STATUS OF PI: PhD student
FACULTY/STAFF/GRADUATE/UNDERGRADUATE Graduate, Undergraduate

1. If PI is a student, is this research to be performed:

- ☐ **for an honors thesis/senior thesis/capstone?** ☐ **for a master's thesis?**
- X **for a doctoral dissertation?** ☐ **for a course project?**
- X **other (specify)** Undergraduate research project for EPSCoR grant

2. Does this application modify a previously approved project? N (Y/N). If yes, please give assigned number (if known) of previously approved project:

3. Is an expedited review requested? Y (Y/N).

SIGNATURES: All procedures performed under the project will be conducted by individuals qualified and legally entitled to do so. No deviation from the approved protocol will be undertaken without prior approval of the IRB.

Faculty Sponsors are responsible for oversight of research conducted by their students. By signing this application page, the Faculty Sponsor ensures that the conduct of such research will be in accordance with the University of Maine's *Policies and Procedures for the Protection of Human Subjects of Research*.

Date	Principal Investigator	Faculty Sponsor
	Co-Investigator	Co-Investigator

****

FOR IRB USE ONLY **Application #** 2011-07-08 **Date received** 7/11/2011 **Review (F/E):** E
Expedited Category: ____

ACTION TAKEN:

- X **Judged Exempt; category** 2 **. Modifications required?** Y **(Y/N) Accepted (date)** 7/21/2011
- ____ **Approved as submitted. Date of next review: by** ____ **. Degree of Risk:** ____
- ____ **Approved pending modifications. Date of next review: by** ____ **. Degree of Risk:** ____
  Modifications accepted (date): ____ .
- ____ **Not approved. (See attached statement.)**
- ____ **Judged not research with human subjects**

Date: 7/13/11 **Chair's Signature:** Cynthia A. Ridley 10/09

APPENDIX F:

FOCUS GROUP PROTOCOL FOR FRENCHMAN BAY PARTNERS

Thank you for taking the time to meet with us today. The Frenchman Bay Partners is moving toward the creation of a Frenchman Bay Plan using the Open Standards for the Practice of Conservation. The plan will include the entire Frenchman Bay watershed with short term projects focused on coastal habitats and species. The next step in this project is to create a shared vision for future planning.

In the near term, the Frenchman Bay Partners will hold a retreat in October, 2011 where stakeholders to further develop a strategic plan for conservation priorities and management options in Frenchman Bay. The Partners are committed to ensuring that diverse perspectives within the watershed are included in this planning process. We appreciate the time you have taken to speak with us today as your insights will contribute to this shared vision.

1. Tell me about your experience on Frenchman Bay.
    What do you do here?
    How would you describe your relationship to the Bay?

2. Have you noticed any changes in the Bay? How do you feel about these changes? What do you think is causing these changes?

3. The Frenchman Bay Planning Group is interested in developing a management plan for the Bay.
    What do you see as the major threats to the Bay?
    How could these threats be addressed?
    What do you see as your role in Frenchman Bay management?

4. As we mentioned at the beginning of the interview, the Frenchman Bay Planning Committee is holding a retreat in the fall. How do we include what is most important to you as part of the Conservation Action Planning retreat?
    What would make your participation worthwhile to you?
    What would you like to see as an outcome of this retreat?
    If you can't attend, what would you want to make sure that the retreat participants know about Frenchman Bay?

5. Based on everything we have talked about, what is most important to you about Frenchman Bay?

6. Is there anything I forgot to ask or anything else you would like to say?

APPENDIX G:

INTERVIEW PROTOCOL FOR PHASE I FRENCHMAN BAY PARTNERS

Thank you for meeting with us today. The goal of this interview is to get a sense of the ongoing collaboration and communication in the Frenchman Bay Steering Committee, of which you are a member. Your comments will help inform the collaboration to identify areas of strength and improvement as the group members work together to realize the conservation plan for the region.

We are also interested in hearing your perspective on the viability of the Bay for the ongoing development of the Frenchman Bay Plan. We appreciate you taking this time to inform these processes.

Warm Up Questions

1. How did you get involved with the Frenchman Bay Partnership? What is your role in the group?

Group Communication

2. Describe your relationship with some of the members of the group. Have you worked with any of them before? If so, how did that go? If not, how do you feel about coming into this group for the first time? What, if anything, do you notice about the communication at the meetings?

3. How do you feel about how the group works together?
    a. Do you feel like you have access to the information you need about the group and its decisions?
    b. How do you get access to this information? How could this access be improved?

4. Do you feel comfortable sharing your views in the group setting? If so, why do you feel this way? If not, how could your level of comfort be improved?

5. Do you feel like your opinion about the Frenchman Bay Partners is heard and influences the planning process?
    a. If so, how do you know this?
    b. If not, what makes you feel like you are not being heard?
    c. Do you think the decision making in the group could be improved? If so, how? If not, what do you like about the way decisions are being made?

6. Do you intend to continue to participate in the group? Why or why not?

Viability Assessment Questions

7. From your experience on Frenchman Bay, what state is (insert conservation target—mud flats, eel grass, bottom habitat, migratory fishes) in?

8. What is the historic condition of this species or habitat?

Probe: Are there particular species within this habitat that are in need of attention?

9. What do you view as the major threats to this species/habitat?

10. What actions, if any, could be taken to improve the quality of this species/ habitat?

We have just two more questions:

11. Who else would you recommend I speak to for further information on this species/habitat?

12. Is there anything you would like to add to this conversation that I did not think to ask?

APPENDIX H:

INTERVIEW PROTOCOL FOR PHASE II FRENCHMAN BAY PARTNERS

Thank you for meeting with us today. The goal of this interview is to get a sense of the ongoing collaboration and communication in the Frenchman Bay Partners process in which you have participated. Your comments will help inform the collaboration to identify areas of strength and improvement as Partners work together to realize the conservation plan for the region. We are also interested in hearing your perspective on economics in the Bay. We appreciate you taking this time to inform these processes.

Group Process, Information Access, Plan Development

1. The Partners are now in their third year as a group. What is your impression of this group?
    a. How has the Frenchman Bay Partners as an entity changed over time and what do you think about these changes?

    b. How do you feel about how the group works together? How have your relationships with other members of the group changed?

    c. Have you met new people through the Partners process? How have these new connections changed your work in the Bay?

2. Do you feel like you have access to the information you need about the Partners and the group decisions?
    a. How do you get access to this information? How could this access be improved?

    b. Do you use the website? Why or why not?
3. The Partners recently adopted an executive committee model with a President, Vice President and other members. What are your thoughts about this new organizational model?
    a. Probe: Will this arrangement change your involvement in the Partners? If so, how?

4. The Partners had a goal setting session in November, which you attended and out of which the Partners developed these specific goals. What do you think about this planning process? Do you think conservation action planning will result in meeting the goals? Why or why not? How could this process be improved?

5. Do you see yourself as a Partner? Why or why not?

Economic Analysis

6. As you know, the Partners have identified working waterfronts as a focus in the conservation action plan. What do you think about how the Partners are addressing this target?

7. What is your understanding of the economic value of mudflats?
    a. Do you know of any resources that might be useful to us as we start to define our goals related to this target? For example, we are using DMR landings data as well as a report from UMaine Machias that has given us some useful information as a starting point to assess the impact of closed clam flats on the region's economy.

8. How do you think the economic benefits of the working waterfront (as it relates to you or your business) should be addressed?

    a. How about the ecological benefits of the working waterfront? What do you see as the relationship between the two? How could this relationship be improved?

Collaborative Capacity Building

You attended [insert here: the collaborative capacity session between clam and mussel harvesters or the session between mussel harvester and eel grass restorers].

9. What are your impressions of this meeting? How did it go? What do you see as the major outcomes of this meeting?

10. What has changed for you since this meeting? Do you have more or less contact with the other resource users? Why?

11. How could this meeting have been improved?

12. Do you see a need for more sessions like this in the Bay? If so, how could the Partners best participate in doing more of this kind of work? What support would you need to continue to work with these other resource users?

13. For mussel harvesters and eel grass restorers: Everyone at the meeting signed the map. What did you think about agreement? Did you have any concerns about it? Do you see yourself sticking to this agreement? Why or why not?

14. For clam harvesters: Did your mussel harvesting ordinance change based on this meeting? If so, how? If not, why not?

Final question for all:

15. Is there anything you would like to add to this conversation that I did not think to ask?

APPENDIX I:

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October 14, 2013

Bridie McGreavy
The University of Maine
Orono, Maine 04469

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BIOGRAPHY OF THE AUTHOR

Bridie McGreavy was born in North Conway, New Hampshire and attended high school at Fryeburg Academy in Fryeburg, Maine. She attended Bates College where she received B.A. in Political Science in 2001. She worked from 2001 through 2010 at Lakes Environmental Association in Bridgton, Maine as the conservation and education director. During this time, she received an M.S. in Environmental Studies with a concentration in Conservation Biology in 2008 from Antioch University New England in Keene, New Hampshire. She has co-authored publications appearing in Sustainability, Environmental Communication: A Journal of Nature and Culture, and Journal of Community Practice, among others. She is a candidate for the Doctor of Philosophy in Communication and Sustainability Science from The University of Maine in December 2013.